INSTALLATION MANUAL

HIGH EFFICIENCY
CLAM TUBE HEAT EXCHANGER SERIES
MODELS: UGAA & UGAB
(Single Stage Upflow/Horizontal)
75 - 100 MBH INPUT
(21.98 - 29.31 KW) INPUT

ISO 9001
Certified Quality
Management System

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SECTION I: SAFETY

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention to the signal words **DANGER**, **WARNING**, or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury**.

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury**.

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.
Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠ CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.

SPECIFIC SAFETY RULES AND PRECAUTIONS

1. Only Natural gas or Propane (LP) gas are approved for use with this furnace. Refer to the furnace rating plate or Section IV of these instructions.
2. Install this furnace only in a location and position as specified in SECTION I of these instructions.
3. A gas-fired furnace for installation in a residential garage must be installed as specified in SECTION I of these instructions.
4. Provide adequate combustion and ventilation air to the furnace space as specified in SECTION VII of these instructions.
5. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in SECTION VII of these instructions.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

6. Test for gas leaks as specified in SECTION IX of these instructions.
7. Always install the furnace to operate within the furnace's intended temperature rise range. Only connect the furnace to a duct system which has an external static pressure within the allowable range, as specified on the furnace rating plate.
8. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air may also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. The return air duct system is required by the furnace manufacturer provided the combustion air and vent system have been installed and maintained as a Two Pipe Sealed Combustion Air System and provided a return air duct system and return air plenum are not required by state, local, or regional codes.
9. It is permitted to be use the furnace for heating of buildings or structures under construction. Installation must comply with all manufacturer's installation instructions including:
   - Proper vent installation;
   - Furnace operating under thermostatic control;
   - Return air duct sealed to the furnace;
   - Air filters in place;
   - Set furnace input rate and temperature rise per rating plate marking;
   - Means for providing outdoor air required for combustion;
   - Return air temperature maintained between 55ºF (13ºC) and 80ºF (27ºC);
   - The **air filter must be replaced** upon substantial completion of the construction process;
   - Clean furnace, duct work and components upon substantial completion of the construction process, and verify furnace-operating conditions including ignition, input rate, temperature rise and venting, according to the manufacturer's instructions.

The following requirements to be met:

a. Clean, outside combustion air is provided to the furnace to minimize the impact of corrosive adhesives, sealants, and other construction materials. Drywall dust is a major concern during construction, which can be pulled into the combustion air path, leading to plugged gas valves, burners, and inducer assemblies.

b. Filter must be installed in the furnace as specified in the installation instructions, and must be replaced or thoroughly cleaned prior to occupancy of the home. Again, drywall dust is the key issue, as that dust can be pulled into the circulating blower motor, plugging the motor vents, coating the rotors and stators, etc. which can lead to a potential fire hazard.

c. The temperature of the return air to the furnace must not be less than 55 degrees F (13 deg C), with no evening setback or furnace shutdown, to prevent condensation in the primary heat exchangers.

d. The air temperature rise must be within the stated rise range as indicated on the furnace rating plate, and the firing input rate must be set to the unit nameplate value.

e. The external static pressure of the air distribution system ductwork must at set for heating operation to be at least 0.10 to 0.20 inches water column, based on the input rate of the furnace, with the lower value for input rates less than 55,000 btu/hr and the upper value for units with input rates above 100,000 btu/hr.

f. A return air duct must be used, sealed to the furnace cabinet, and terminated outside the space where the furnace is installed. This prevents any recirculation of supply air, which can generate a negative pressure condition at the furnace for non-direct vent furnaces, leading to possible flame rollout or combustion problems.

g. The furnace and ductwork should be thoroughly and completely cleaned prior to occupancy of the dwelling to insure the proper operation of the furnace and to avoid potential health concerns.

10. When installed in a Manufactured (Mobile) Home, Modular Home, or building constructed on-site, combustion air must never be supplied from occupied spaces.
11. The size of the unit should be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods may be used.
12. Mobile Home Installations:
    This appliance must be installed with a vent terminate in the same atmospheric zone, external to the building.
13. Modular and Manufactured (Mobile) Home Installations:
    This appliance must be installed so that the vent pipe from the vent connection on the furnace can be easily connected to a B type vent that terminates outdoors. This appliance cannot be connected to a vent that is serving another appliance. This appliance shall be installed in an area where there is an adequate supply of combustion air available to assure proper combustion and ambient air temperatures are maintained within safe operating limits.
    If an adequate supply of combustion air is not available to assure proper combustion and ventilation air, outside air shall be introduced to the space in which the appliance is located. An outside combustion air duct may be used to provide the outside air to the space. Refer to ANSI Z223.1 National Fuel Gas Code or in Canada B149-00 National Gas and Propane Installation Code for proper duct sizing and installation.

NOTE: Air for combustion must never be taken from occupied spaces. Appliance combustion air must be provided from outdoors.

14. Modular Home Definition:
    Factory-built home constructed to the state, local, or regional code where the house will be located. The home is transported in one or more modules and joined at the home site.
15. Mobile Home Definition:
    Factory-built home constructed, transported, and installed under the federal building code administered by the U.S. Department of Housing and Urban Development (HUD Code), rather than to building codes at their destination. The house is built, transported, and installed on a non-removable chassis.
16. This furnace is not approved for installation in trailers or recreational vehicles.

SAFETY REQUIREMENTS

- A manufactured (mobile) home installation must conform with the Manufactured Home Construction and Safety Standard, Title 24 CFR, Part 3280, or when such standard is not applicable, the standard for Manufactured Home Installations (Manufactured Home Sites, Communities, and Set-ups) ANSI/NCS A225.1, and/or the Canadian Standard for CAN/CSA Z240 MH, Series M92 Mobile Homes. Furnaces have been certified to the latest edition of standard ANSI Z21-47 • CSA 2.3.
- Refer to the unit rating plate for the furnace model number, and then see the dimensions page of this instruction for return air plenum dimensions in Figure 1. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed under Clearances to Combustibles.
- Provide clearances for servicing ensuring that service access is allowed for both the burners and blower.
- These models are CSA listed or approved for installation into a Modular Home or a Manufactured (Mobile) Home.
- **Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, death, personal injury and/or property damage.**
- Furnaces for installation on combustible flooring shall not be installed directly on carpeting, tile or other combustible material other than wood flooring.
- Check the rating plate and power supply to be sure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase, 60-Hertz power supply. DO NOT CONNECT THIS APPLIANCE TO A 50 HZ POWER SUPPLY OR A VOLTAGE ABOVE 130 VOLTS.
- Furnace shall be installed so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas fired components. Only trained and qualified personnel should install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
- These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances these instructions exceed certain local codes and ordinances, especially those who have not kept up with changing manufactured (mobile) home and modular home construction practices. These instructions are required as a minimum for a safe installation.

COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in any of the following environments.

- Restricted Environments
- Commercial buildings
- Buildings with indoor pools
- Furnaces installed in laundry rooms
- Furnaces installed in hobby or craft rooms
- Furnaces installed near chemical storage areas
- Chemical Exposure

The furnace will require **OUTDOOR AIR** for combustion when the furnace is located in an area where the furnace is being exposed to the following substances and / or chemicals.

- Permanent wave solutions
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- De-icing salts or chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- Hydrochloric acid
- Cements and glues
- Antistatic fabric softeners for clothes dryers
- Masonry acid washing materials

If outdoor air is used for combustion, the combustion air intake duct system termination must be located external to the building and in an area where there will be no exposure to the substances listed above.

⚠WARNING

The furnace area must not be used as a broom closet or for any other storage purposes, as a fire hazard may be created. Never store items such as the following on, near or in contact with the furnace.

1. Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners or other cleaning tools.
2. Soap powders, bleaches, waxes or other cleaning compounds; plastic items or containers; gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids or other volatile fluid.
3. Paint thinners and other painting compounds.
4. Paper bags, boxes or other paper products

Never operate the furnace with the blower door removed. To do so could result in serious personal injury and/or equipment damage.

INSPECTION

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing. Also, before installation, the unit should be checked for screws or bolts, which may have loosened in transit, and have shipping or spacer brackets which need to be removed.

FURNACE LOCATION AND CLEARANCES

The furnace shall be located using the following guidelines:

1. Where a minimum amount of vent piping and elbows will be required.
2. As centralized with the air distribution as possible.
3. Where it will not interfere with proper air circulation in the confined space.
4. Where the outdoor vent terminal will not be blocked or restricted. Refer to "VENT CLEARANCES" located in SECTION VII of these instructions. These minimum clearances must be maintained in the installation.
5. Where the unit will be installed in a level position with no more than 1/4" (0.64 cm) slope side-to-side and front-to-back to provide proper condensate drainage.

Installation in freezing temperatures:

1. Furnace shall be installed in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures falling below 32° F (0° C) may result in the flue temperature falling below 260° F (127° C) at any point in the flue pipe. The flue products will condense in the vent pipe if the flue temperature falls below 260° F (127° C) causing the vent pipe to deteriorate rapidly.
2. Do not allow return air temperature to be below 55º F (13° C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.

⚠WARNING

Improper installation in an ambient below 32ºF (0.0° C) could create a hazard, resulting in damage, injury or death.

3. If this furnace is installed in an unconditioned space and an extended power failure occurs, there will be potential damage to the internal components. Following a power failure situation, do not operate the unit until inspection and repairs are performed.

Clearances for access:

Ample clearances should be provided to permit easy access to the unit. The following minimum clearances are recommended:

1. Twenty-four (24) inches (61 cm) between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
2. Eighteen (18) inches (46 cm) at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

In all cases, accessibility clearances shall take precedence over clearances for combustible materials where accessibility clearances are greater.

Installation in a residential garage:

3. A gas-fired furnace for installation in a residential garage must be installed so the burner(s) and the ignition source are located not less than 18 inches (46 cm) above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

TABLE 1: Unit Clearances to Combustibles

APPLICATION	TOP	FRONT	REAR	SIDES	SINGLE WALL VENT	FLOOR/ BOTTOM	CLOSET	ALCOVE	ATTIC	LINE CONTACT
	In. (cm)	In. (cm)	In. (cm)	In. (cm)	In. (cm)					
UPFLOW	1 (2.54)	2 (5.08)	0 (0.0)	0 (0.0)	6 (15.24)	COMBUSTIBLE	YES	YES	YES	NO
UPFLOW B-VENT	1 (2.54)	1 (2.54)	0 (0.0)	0 (0.0)	N/A	COMBUSTIBLE	YES	YES	YES	NO
HORIZONTAL	1 (2.54)	2 (5.08)	0 (0.0)	1 (5.08)	6 (15.24)	COMBUSTIBLE	NO	YES	YES	YES[1]
HORIZONTAL B-VENT	1 (2.54))	1 (2.54)	0 (0.0)	0 (0.0)	N/A	COMBUSTIBLE	NO	YES	YES	YES[1]

1. Line contact only permitted between lines formed by the intersection of the rear panel and side panel (top in horizontal position) of the furnace jacket and building joists, studs or framing.

SECTION II: DUCTWORK

DUCTWORK GENERAL INFORMATION

The duct system's design and installation must:

1. Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
2. Be installed in accordance with standards of NFPA (National Fire Protection Association) as outlined in NFPA pamphlets 90A and 90B (latest editions) or applicable national, provincial, or state, and local fire and safety codes. In Canada refer to the National Gas and Propane Installation Code B149.1-00, Provincial, Local Fire and Safety Codes.
3. **For manufactured (mobile) home and modular home return duct system installation:** The return air duct and the return air plenum are required by the furnace manufacturer.
4. Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment. Air must circulate to and from the conditioned space.

⚠ CAUTION

The cooling coil must be installed in the supply air duct, downstream of the furnace. Cooled air may not be passed over the heat exchanger.

When the furnace is used in conjunction with a cooling coil, the coil must be installed parallel with, or in the supply air side of the furnace to avoid condensation in the primary heat exchanger. When a parallel flow arrangement is used, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position.

⚠WARNING

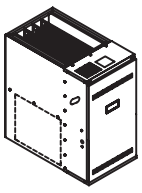
The duct system must be properly sized to obtain the correct airflow for the furnace size that is being installed.

Refer to Table 8 and the furnace rating plate for the correct rise range and static pressures

If the ducts are undersized, the result will be high duct static pressures and/or high temperature rises which can result in a heat exchanger OVERHEATING CONDITION. This condition can result in premature heat exchanger failure, which can result in personal injury, property damage, or death.

DUCTWORK INSTALLATION

Upflow Instructions



Attach the supply plenum to the furnace outlet duct connection flanges. This is typically through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. This connection should be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace. If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all.

The duct system is a very important part of the installation. **If the duct system is improperly sized the furnace will not operate properly.** The ducts attached to the furnace plenum, should be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Table 2 is a guide for determining whether the rectangular duct system that the furnace is being connected to be of sufficient size for proper furnace operation.

Use the Example below to help you in calculating the duct area to determine whether the ducts have sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Example: The furnace input is 80,000 BTUH, 1,200 CFM. The recommended duct area is 280 sq.in, there are two 8 x 14 rectangular ducts attached to the plenum and there are two 7 inch round ducts attached to the furnace.

1. Take 8 x 14, which equals 112 sq.in. X 2, which equals 224 square inch then go to round duct size located in Table 2.
2. The square inch area for 7 inch round pipe is 38.4, multiply by 2 for two round ducts which equals 76.8 square inch.
3. Then take the 224 square inch from the rectangular duct and add it to the 76.8 sq.in. of round duct. The total square inch of duct attached to the furnace plenum is 300.8 square inch. This exceeds the recommended 280 square inch of duct.

In this example, the duct system attached to the plenum has a sufficient area so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

Consideration should be given to the heating capacity required and also to the air quantity (CFM) required. These factors can be determined by calculating the heat loss and heat gain of the home or structure. If these calculations are not performed and the furnace is over-sized, the following may result:

1. Short cycling of the furnace.
2. Wide temperature fluctuations from the thermostat setting.
3. Reduced overall operating efficiency of the furnace.

The supply and return duct system must be of adequate size and designed such that the furnace will operate within the designed air temperature rise range and not exceed the maximum designed static pressure. These values are listed in the table below.

TABLE 2: Minimum Duct Sizing For Proper Airflow

Input	Airflow	Return[1]	Rectangular[2]	Round[2]	Supply[3]
BTU/H (kW)	CFM (m^3)	In² (cm^2)	in. x in. (cm x cm)	in. (cm) dia.	In² (cm^2)
75000 (21.98)	1,200 (33.98)	280 (711)	14 x 20 (35.6 x 50.8)	18 (45.7)	216 (549)
75000 (21.98)	1,600 (45.31)	360 (914)	18 x 20 (45.7 x 50.8))	22 (55.8)	280 (711)
100000 (29.31)	1,600 (45.31)	360 (914)	18 x 20 (45.7 x 50.8)	22 (55.8)	280 (711)
NOTE: This chart does not replace proper duct sizing calculations or take into account static pressure drop for run length and fittings. Watch out for the temperature rise and static pressures.					

1. Maximum return air velocity in rigid duct @ 700 feet per minute (19.82 m^3 / minute).
2. Example return main trunk duct minimum dimensions.
3. Maximum supply air velocity in rigid duct @ 900 feet per minute (25.49 m^3 / minute).

TABLE 3: External Static Pressure Range

Input		Output		Nominal Air Flow		Ext. Static Pressure			
						Minimum		Maximum	
MBH	kW	MBH	kW	CFM	cmm	In.W.C	kPa	In.W.C	kPa
75	22.0	60	17.6	1200	34.0	0.12	0.0299	0.50	0.1245
75	22.0	60	17.6	1600	45.3	0.12	0.0299	0.50	0.1245
100	29.3	80-	23.4	1600	45.3	0.15	0.0374	0.50	0.1245

TABLES 2 and 3 are to be used as a guide only to help the installer determine if the duct sizes are large enough to obtain the proper air flow (CFM) through the furnace. TABLES 2 and 3 ARE NOT to be used to design ductwork for the building where the furnace is being installed. There are several variables associated with proper duct sizing that are not included in the tables. To properly design the ductwork for the building, Refer to the ASHRAE Fundamentals Handbook, Chapter on "DUCT DESIGN" or a company that specializes in Residential and Modular Home duct designs.

IMPORTANT: The minimum plenum height is 12" (30.5). The furnace will not operate properly on a shorter plenum height. The minimum recommended rectangular duct height is 4 inches (10 cm) attached to the plenum.

IMPORTANT: The air temperature rise should be taken only after the furnace has been operating for at least 15 minutes. Temperatures and external static pressures should be taken 6" (15 cm) past the first bend from the furnace in the supply duct and the return duct. If an external filter box or an electronic air cleaner is installed, take the return air readings before the filter box or air cleaner.

⚠WARNING

*The supply air temperature **MUST NEVER** exceed the **Maximum Supply Air Temperature**, specified on the nameplate.*

Operating the furnace above the maximum supply air temperature will cause the heat exchanger to overheat, causing premature heat exchanger failure. Improper duct sizing, dirty air filters, incorrect manifold pressure, incorrect gas orifice and/or a faulty limit switch can cause the furnace to operate above the maximum supply air temperature. Refer to sections II, III and IX for additional information on correcting the problem.

If a matching cooling coil is used, it may be place directly on the furnace outlet and sealed to prevent leakage. Follow the coil instructions for installing the supply plenum. On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

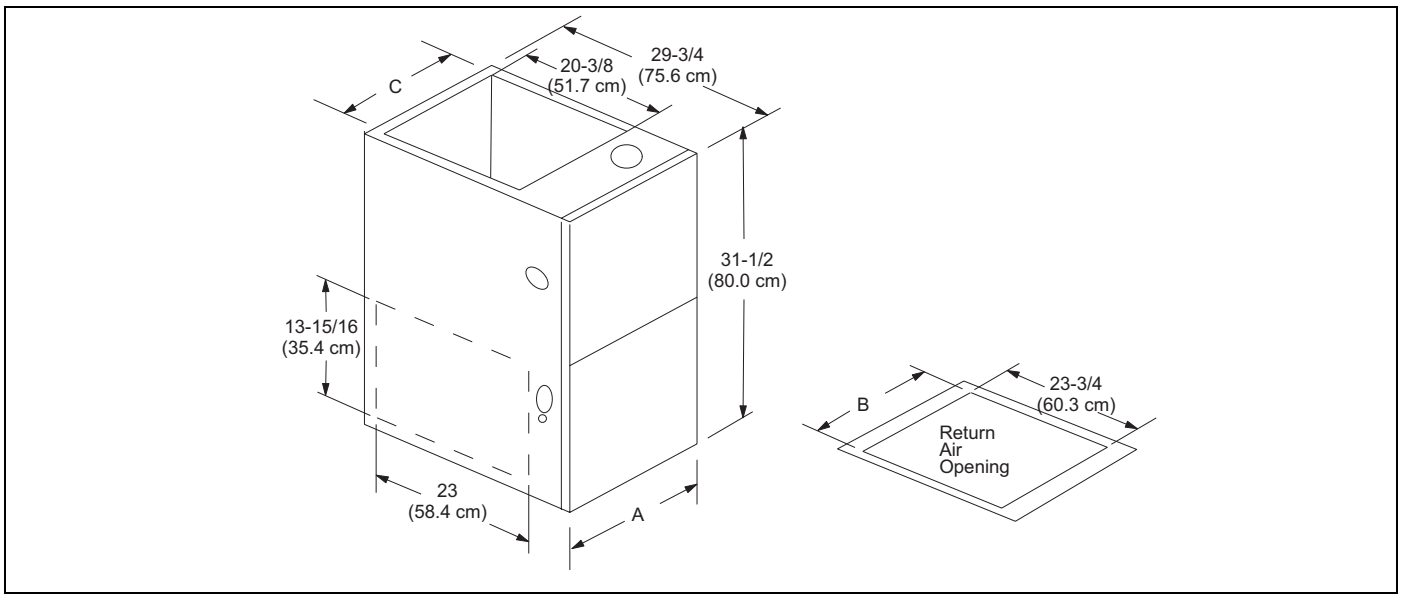


FIGURE 1: Dimensions

TABLE 4: Cabinet and Duct Dimensions

BTUH (kW) Input/Output	CFM (m^3/min)	Cabinet Size	Cabinet Dimension					
			A(in.)	A(cm)	B(in.)*	B(cm)*	C(in.)*	C(cm)*
75/60 (22.0/17.6)	1200 (33.98)	B	17 1/2	44.5	16 1/2	41.9	20 3/8	51.8
75/60 (22.0/17.6)	1600 (45.31)	C	21	53.3	20	50.8	20 3/8	51.8
100/80 (29.3/23.4)	1600 (45.31)	C	21	53.3	20	50.8	20 3/8	51.8

* Dimensions “B”, “C”, “D”, and “E” are with duct flanges turned up. “F”, “G”, “H”, and “J” are with flanges flat.

MOBILE HOME AND MODULAR HOME UPFLOW RETURN PLENUM CONNECTION

Return air may enter the furnace through the side(s) or bottom depending on the type of application. Return air may not be connected into the rear panel of the unit. For single return application, see data and notes on blower performance data tables in this manual.

BOTTOM RETURN AND ATTIC INSTALLATIONS

Bottom return applications normally pull return air through a base platform or return air plenum. Be sure the return platform structure or return air plenum is suitable to support the weight of the furnace.

The return air ducts to the furnace must have a total cross sectional area of not less than two square inches per 1000 BTUH of furnace input rating for heating operation. If air conditioning is to be installed with the furnace, larger return air ducts may be required, depending on the capacity of the air conditioner and the airflow required. The return air opening in the top of the furnace is large enough for the largest capacity air conditioner for which the furnace blower is rated. The return air duct or plenum can be connected to the furnace by performing the following steps:

1. Bend the 3/4" (1.905 cm) flanges that will be used to attach the return air plenum using the scribe marks in the furnace base. Refer to Figure 1 for flange locations.
2. Be sure to seal the furnace to plenum connections to prevent air leakage. Refer to Figure 1 for unit and plenum dimensions.

Attic installations must meet all minimum clearances to combustibles and have floor support with required service accessibility.

INSTALLATION RECOMMENDATIONS

FLOOR INSTALLATIONS

As shown below in Figure 2, the furnace may be installed directly on the floor of the home, using a side return air connection. A short duct should be connected to the side cutout in the furnace casing. The other end of the return air duct should be connected to a minimum 25" x 16" filter grille. If a Blend Air ventilation system is to be installed, the return air duct must be long enough so that the Blend Air damper can be mounted in the top of the duct.

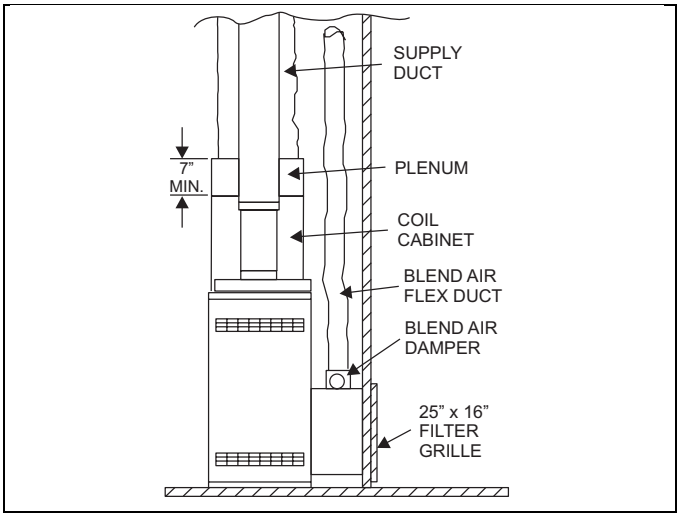


FIGURE 2: Floor Installation

PLATFORM INSTALLATIONS

As shown below in Figure 3, the furnace may be installed on a raised platform. The platform must be a minimum of 20" in height and a filter grille with a minimum area of 25" x 16" must be mounted in the front, back or side of the platform. If a Blend Air ventilation system is to be installed, the platform must be wide enough so that the Blend Air damper can be mounted in the top of the platform

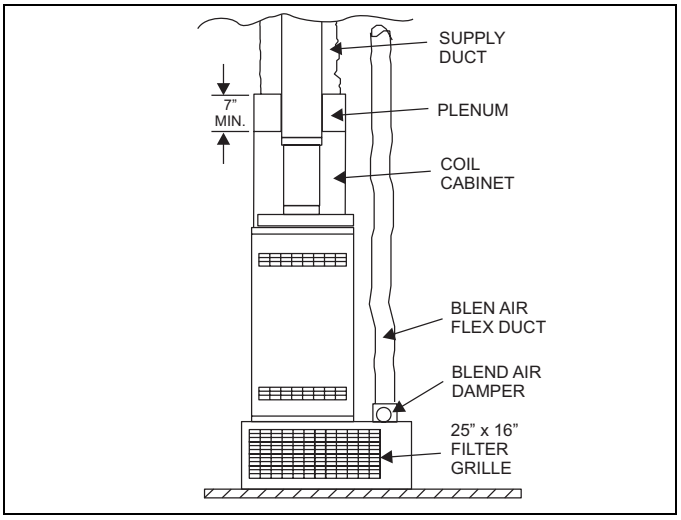
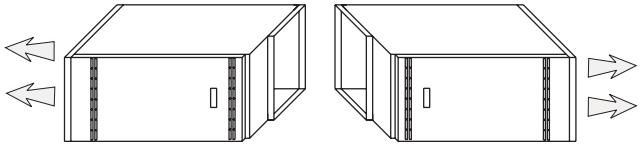


FIGURE 3: Platform Installation

HORIZONTAL MODELS



Horizontal Installations With a Cooling Coil Cabinet

The furnace should be installed with coil cabinet part number specifically intended for Horizontal application. If a matching cooling coil is used, it may be placed directly on the furnace outlet and sealed to prevent leakage. Follow the coil instructions for installing the supply plenum. For details of the coil cabinet dimensions and installation requirements, refer to the installation instructions supplied with the coil cabinet

The perforations in the wrapper flanges must be bent away from the heat exchanger to create duct flanges so the air conditioning coil can be properly seated on the furnace.

Attach the supply plenum to the air conditioning coil cabinet outlet duct flanges through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. The connection to the furnace, air conditioning coil cabinet and the supply plenum should be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

The minimum plenum height is 12" (30.5 cm). If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all. Also the plastic drain pan in the air conditioning coil can overheat and melt. Refer to the installation instructions supplied with the air conditioning coil for additional information.

Horizontal Installations Without a Cooling Coil Cabinet

When installing this appliance, the furnace must be installed so as to create a closed duct system, the supply duct system must be connected to the furnace outlet and the supply duct system must terminate outside the space containing the furnace. When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace.

Attach the supply plenum to the furnace outlet duct flanges through the use of S cleat material when a metal plenum is used. The use of an approved flexible duct connector is recommended on all installations. This connection should be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized. On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

Mobile Home and Modular Home Upflow/Horizontal Return Plenum Connections

The return air duct and the return air plenum is required by the furnace manufacturer.

If a upflow return air duct system and return plenum are required by state, local, or regional codes then the return plenum may be connected to the furnace inlet and must terminate outside the space containing the furnace. The external air filter accessory shown in Figure 7 is designed and recommended for use inside the return plenum.

Attach the return plenum to the furnace inlet duct flanges. This is typically through the use of S cleat material when a metal plenum is used for installations where a return air duct system is utilized, the use of a listed flexible duct connector is recommended. The connection of the plenum to the furnace and all the ducts connecting to the plenum must be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

The duct system is a very important part of the installation. If the duct system is improperly sized the furnace will not operate properly. The ducts attached to the furnace must be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate and in Table 8.

An upflow return air duct and plenum can be attached to the bottom, side, both sides, or bottom and side of the furnace as shown in Figure 4.

Attic and crawl space installations must meet all minimum clearances to combustibles and have floor support with required service accessibility Refer to Figures 4 and 5. All attic and crawl space installations must have a return air duct system and return plenum. Horizontal installations require a single return duct as shown in Figure 4. A side return is not required in a horizontal application.

IMPORTANT: When replacing an existing furnace, if a return air plenum is used and the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace. If a return duct mounted filter rack or filter grille is being used see the instructions provided with that accessory for proper hole cut size.

ATTIC INSTALLATION

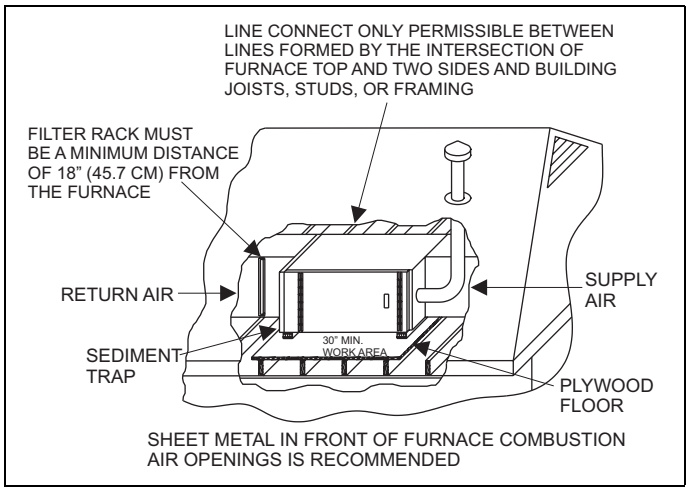

LINE CONNECT ONLY PERMISSIBLE BETWEEN LINES FORMED BY THE INTERSECTION OF FURNACE TOP AND TWO SIDES AND BUILDING JOISTS, STUDS, OR FRAMING
FILTER RACK MUST BE A MINIMUM DISTANCE OF 18" (45.7 CM) FROM THE FURNACE
RETURN AIR
SUPPLY AIR
SEDIMENT TRAP
30" MIN. WORK AREA
PLYWOOD FLOOR
SHEET METAL IN FRONT OF FURNACE COMBUSTION AIR OPENINGS IS RECOMMENDED

FIGURE 4: Typical Attic Installation

This appliance is design certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs or framing. This line may be in contact with combustible material.

⚠WARNING

When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12 inches (30.5 Cm) away from furnace and burner combustion air openings.

SUSPENDED FURNACE / CRAWL SPACE INSTALLATION

The furnace can be hung from floor joists or installed on suitable blocks or pad. Blocks or pad installations shall provide adequate height to ensure the unit will not be subject to water damage. Units may also be suspended from rafters or floor joists using rods, pipe angle supports or straps. Angle supports should be placed at the supply air end and near the blower deck. Do not support at return air end of unit. All four suspension points must be level to ensure quiet furnace operation. When suspending the furnace, use a secure platform constructed of plywood or other building material secured to the floor joists. Refer to Figure 5 for typical crawl space installation.

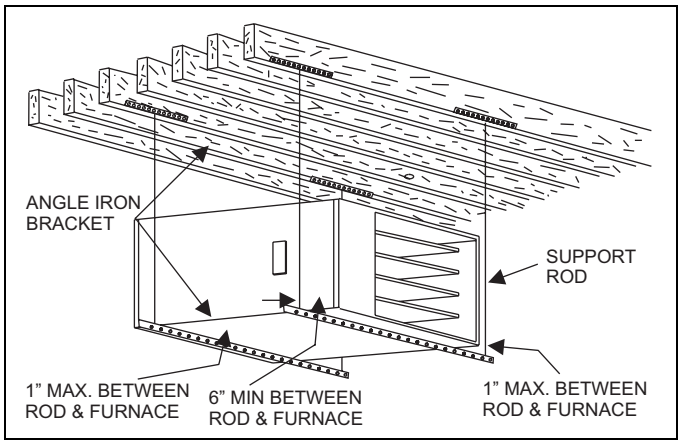


FIGURE 5: Typical Suspended Furnace / Crawl Space Installation

SECTION III: FILTERS

FILTER INSTALLATION

All applications require the use of a filter. Models must have a field-supplied filter and mounting hardware. Replacement filter size is shown in Table 5.

TABLE 5: Filter Sizes - Upflow

UPFLOW						Cabinet Size	Side Return		Bottom/End Return	
Input		Output		Air Flow						
MBH	kW	MBH	kW	CFM	cmm		in.	cm	in.	cm
75	22.0	60	17.6	1200	34.0	B	25 x 16	64 x 41	24 x 15	61 x 38
75	22.0	60	17.6	1600	45.3	C	25 x 16	64 x 41	24 x 18	61 x 46
100	29.3	80	23.4	1600	45.3	C	25 x 16	64 x 41	24 x 18	61 x 46

SIDE RETURN/BOTTOM EXTERNAL INSTALLATION

Locate and knock out the square corner locators. These indicate the size of the cutout to be made in the furnace side panel. Refer to Figures 1 and 6.

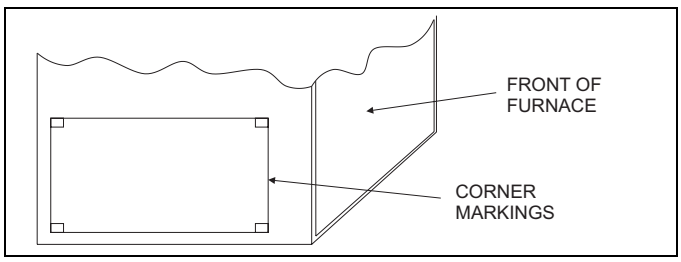


FIGURE 6: Side Return Cutout Markings

Install the side filter rack following the instructions provided with that accessory. If a filter(s) is provided at another location in the return air system, the ductwork may be directly attached to the furnace side panel. An accessory filter rack is available for mounting the filter external to the cabinet.

Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with that accessory for side opening requirements. Do not cut the opening larger than the dimensions shown in Figure 1.

EXTERNAL FILTER INSTALLATION FOR UPFLOW/HORIZONTAL CONFIGURATIONS

1. Select desired filter position for upflow/horizontal (left/right side, bottom). Remove the corresponding cabinet cut-outs per instructions provided.
2. Install the external filter box to the side of the cabinet and secure to the cabinet as specified in the instructions provided with the air filter kit. If a side return is to be used, cut out the side of the casing 14" high by 16 1/4" wide using the lances in the casing side as a guide. DO NOT CUT THE OPENING LARGER THAN 14" X 16 1/4". It is not permissible to cut out the back of the furnace. For bottom returns, place the external filter box between the return air plenum and the base of the furnace. The casing bottom is embossed to indicate where to bend the flanges. Refer to Figure 1 for the maximum return air opening sizes. Seal this connection to prevent leaks.
3. Install the return air duct to the air filter box and secure with screws. Seal this connection to prevent leaks.
4. Install the field provided filter. Refer to Table 5 for the recommended filter size for your furnace.

NOTE: Air velocity must not exceed 300 feet per minute through low velocity disposable filters. Air velocity must not exceed 650 feet per minute through high velocity cleanable permanent filters. Use of a filter that is too small will cause static pressure in the duct system to be too high, which will have an adverse effect on heating and cooling operation.

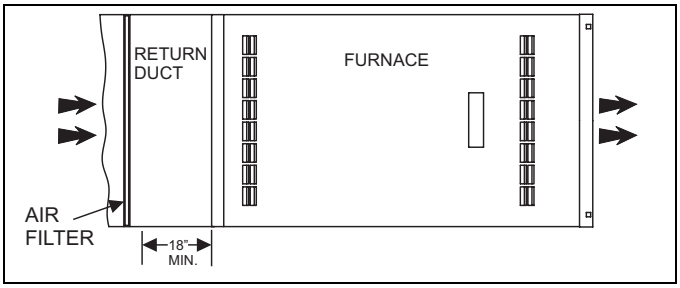


FIGURE 7: Horizontal Mount and Filter

If the accessory electronic air cleaner is installed, be sure the air cleaner is designed to accommodate the furnace CFM (cm/m) and the air cleaner is installed so it does not obstruct the return airflow. Consideration should be given when locating the air cleaner for maintenance and temperatures should the indoor fan motor fail to operate. The use of straps and / or supports is required to support the weight of the electronic air cleaner. It is recommended that the air cleaner not be located within 12 inches (2.5 cm) from the top of the return air opening on the furnace. Refer to the instructions supplied with the electronic air cleaner.

If pleated media air filters or any filter that has a large pressure drop is installed in the return air duct system be sure that the pressure drop caused by the air filter will not prevent the furnace from operating within the rise range specified on the rating plate. If the furnace does not operate within the specified rise range then a larger air filter or an air filter that has a lower pressure drop must be installed. Refer to Table 16 and the furnace accessories for accessory external filter kit options.

IMPORTANT: Air velocity through throwaway type filters must not exceed 300 feet per minute (1.52 m/m). All velocities over this require the use of high velocity filters. Refer to Table 16.

SECTION IV: GAS PIPING

GAS SAFETY

⚠DANGER

This furnace is designed to operate on NATURAL GAS or PROPANE GAS ONLY. Do not burn any other fuel in this furnace. Burning any fuel except NATURAL GAS or PROPANE GAS can cause premature heat exchanger burnout, high levels of carbon monoxide, excessive sooting, a fire hazard, personal injury, property damage and /or death.

⚠DANGER

An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 PSI (14" w.c. (3.48 kPa)). Pressures exceeding 0.5 PSI (14" w.c. (3.48 kPa)) at the gas valve will cause damage to the gas valve, resulting in a fire or explosion or cause damage to the furnace or some of its components that will result in property damage and loss of life.

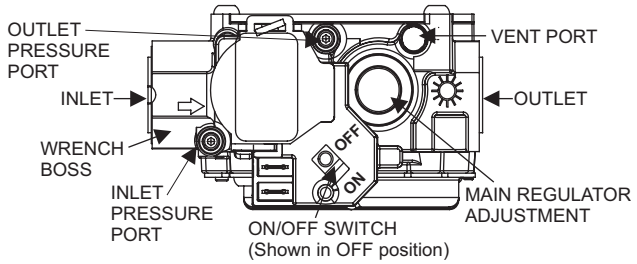


FIGURE 8: Gas Valve

CHECKING THE GAS PRESSURES

1. The pressure ports on the gas valve are marked OUT P and IN P.
2. The manifold pressure must be taken at the port marked OUT P.
3. The inlet gas supply pressure must be taken at the port marked IN P.
4. Using a 3/32" (0.2 cm) Allen wrench, loosen the set screw by turning it 1 turn counter clockwise. DO NOT REMOVE THE SET SCREW FROM THE PRESSURE PORT.
5. Push one end the 3/8" (0.9 cm) ID flexible tubing over the pressure port so that the body of the port is inside the tubing.
6. Use a reducer connector to connect the 3/8" (0.9 cm) ID flexible tube to a 1/4" (0.9 cm) ID flexible tube that is connected to a "U" tube manometer or digital pressure measuring equipment.

TABLE 6: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5" W.C. (1.12 kPa)	8.0" W.C. (1.99 kPa)
Maximum	10.5" W.C. (2.61 kPa)	13.0" (3.24 kPa) W.C.

IMPORTANT: The inlet gas pressure operating range table specifies the minimum and maximum gas line pressures required for safe furnace operation.

The minimum inlet gas pressure required to obtain the BTU input specified on the rating plate and in these instructions is shown below:

- 4.5" W.C. (1.12 kPA) for Natural Gas
- 11.0" W.C. (2.74 kPA) for Propane (LP) Gas

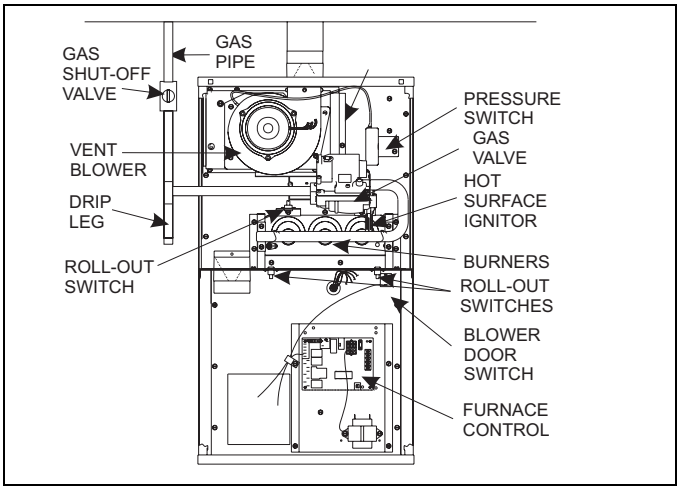


FIGURE 9: Upflow Configuration

GAS PIPING INSTALLATION

Properly sized wrought iron, approved flexible or steel pipe must be used when making gas connections to the unit. If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. Refer to Figure 10.

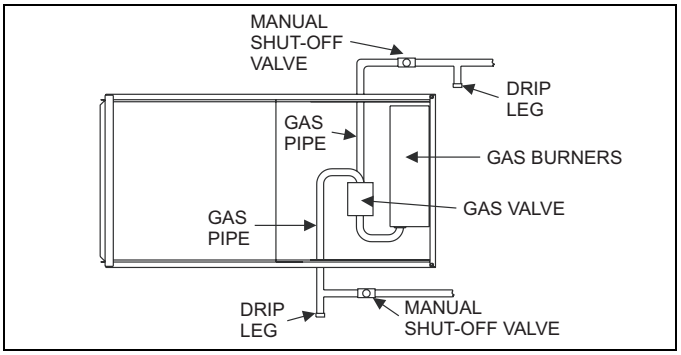


FIGURE 10: Horizontal Gas Piping

IMPORTANT: An accessible manual shut-off valve must be installed upstream of the furnace gas controls and within 6 feet (1.8 m) of the furnace. Refer to Figures 9 and 10.

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (3.5 kPa).

⚠ CAUTION

The gas valve body is a very thin casting that cannot take any external pressure. Never apply a pipe wrench to the body of the gas valve when installing piping. A wrench must be placed on the octagon hub located on the gas inlet side of the valve. Placing a wrench to the body of the gas valve will damage the valve causing improper operation and/or the valve to leak.

Gas piping may be connected from either side of the furnace using any of the gas pipe entry knockouts on both sides of the furnace. Refer to Figure 1 dimensions.

GAS ORIFICE CONVERSION FOR PROPANE (LP)

Refer to Table 7 for the proper gas orifice size.

⚠WARNING

The conversion shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency is responsible for the proper installation. The installation is not proper and complete until the operation of the converted appliance is checked as specified in the manufacturer's instructions.

⚠WARNING

Improper installation may damage equipment, can create a shock hazard, and will void the warranty.

IMPORTANT: These instructions are for the use of qualified individuals specially trained, experienced and certified in the installation of this type of equipment and related system components. Installation and service personnel are required by some states to be licensed. Persons not qualified shall not install this equipment nor interpret these instructions.

NOTE: The words "Shall" or "Must" indicate a requirement, which is essential to satisfactory and safe product performance.

NOTE: The words "Should" or "May" indicate a recommendation or advice which is not essential and not required but which may be useful or helpful.

CONTENTS

1. Burner orifices for LP (propane) gas are located in bag attached to the gas valve.
2. Conversion plate.

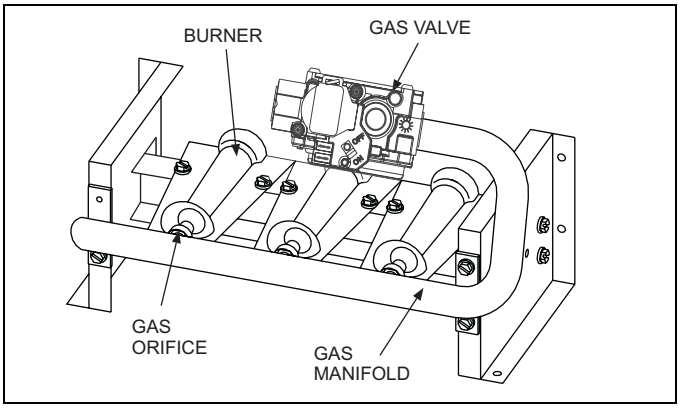


FIGURE 11: Burner Assembly

CONVERSION PROCEDURE

⚠ CAUTION

The gas supply must be shut off prior to disconnecting the electrical power, before proceeding with the conversion.

⚠WARNING

***SHOCK HAZARD -** Turn off electrical supply to furnace*

1. Shut off gas supply at valve upstream from furnace or at meter as required. Refer to Figures 9 and 10.
2. Disconnect as supply piping from gas valve on furnace.
3. Disconnect electrical wires from gas valve, nothing which wires are connected to which terminals.
4. Remove the four screws that attach the gas manifold to the burner support box. See Figure 11.
5. Remove and discard natural gas orifices.
6. Remove LP (Propane) orifices from the bag attached to the gas valve.
7. Install the LP (Propane) gas orifices supplied with the furnace. Tighten to 15 - 25 inch - pounds of torque.
8. Reinstall the manifold in the assembly by reversing the removal process.
9. Reconnect the wires to the proper terminals on the gas valve.
10. Remove the regulator with the blue cap and turn it upside down so the letters "LP" are upright. Place the blue cap on the opposite end of the regulator.
11. Convert the gas valve for LP (propane) gas operation by following the instructions. Remove the natural tag and replace with the propane tag supplied in the orifice bag to the gas burner mounting plate to show that is has been converted.
12. Remove the blue conversion label on the furnace door after the furnace has been converted.
13. Reconnect the gas supply piping to the gas valve and insure that all gas connections are tight.
14. Remove pressure tap plugs from gas valve and connect water gauge to the pressure tap ports. See Figure 8 for location of the gas valve pressure taps and pressure regulator adjustment.
15. Turn on gas supply to furnace and check all gas connections with suitable leak detector.

⚠WARNING

Never use an open flame to check for leaks. Fire or explosion could occur. Since some leak solutions including soap and water may cause corrosion or stress cracking, the piping must be rinsed with water after testing unless it has been determined that the leak test solution is non-corrosive.

HIGH ALTITUDE GAS ORIFICE CONVERSION

This furnace is constructed at the factory for natural gas-fired operation at 0 – 2,000 ft. (0 m – 610 m) above sea level.

The gas orifices on this furnace must be changed in order to maintain proper and safe operation, when the furnace is installed in a location where the altitude is greater than 2,000 ft. (610 m) above sea level on natural gas or the altitude is greater than 4,000 ft. (1219 m) above sea level on propane (LP) gas. Refer to Table 7 or the instructions in the high altitude conversion kit for the proper gas orifice size.

The unit may also be converted for altitudes up to 10,000 ft. (3048 m) on natural and propane (LP) gas with additional derate as shown in Table 7 or refer to ANSI Z223.1 NFPA 54 National Fuel Gas Code or in Canada CAN/CGA-B149.1-00 Natural Gas and Propane Installation Code.

⚠DANGER

PROPANE AND HIGH ALTITUDE CONVERSION KITS

It is very important to choose the correct kit and/or gas orifices for the altitude and the type of gas for which the furnace is being installed.

Only use natural gas in furnaces designed for natural gas. Only use propane (LP) gas for furnaces that have been properly converted to use propane (LP) gas. Do not use this furnace with butane gas.

Incorrect gas orifices or a furnace that has been improperly converted will create an extremely dangerous condition resulting in premature heat exchanger failure, excessive sooting, high levels of carbon monoxide, personal injury, property damage, a fire hazard and/or death.

High altitude and propane (LP) conversions are required in order for the appliance to satisfactory meet the application.

An authorized distributor or dealer must make all gas conversions.

In Canada, a certified conversion station or other qualified agency, using factory specified and/or approved parts, must perform the conversion.

The installer must take every precaution to insure that the furnace has been converted to the proper gas orifice size when the furnace is installed. Do not attempt to drill out any orifices to obtain the proper orifice size. Drilling out a gas orifice will cause misalignment of the burner flames, causing premature heat exchanger burnout, high levels of carbon monoxide, excessive sooting, a fire hazard, personal injury, property damage and/or death.

TABLE 7: High Altitude Conversion

Type Of Gas	Orifice at Sea Level	2,000 ft. (610 m)	3,000 ft. (914 m)	4,000 ft. (1219 m)	5,000 ft. (1524 m)
Natural	#42	#42	#43	#43	#43
Propane	#54	#54	#55	#55	#55
Type Of Gas	**6,000 ft. (1829 m)**	**7,000 ft. (2134 m)**	**8,000 ft. (2438 m)**	**9,000 ft. (2743 m)**	**10,000 ft. (3048 m)**
Natural	#44	#44	#45	#46	#47
Propane	#55	#55	#56	#56	#56

SECTION V: ELECTRICAL POWER

Electrical Power Connections

Field wiring to the unit must be grounded. Electric wires that are field installed shall conform to the temperature limitation for 63°F (35°C) rise wire when installed in accordance with instructions. Refer to Table 8 in these instructions for specific furnace electrical data.

⚠ CAUTION

Use copper conductors only.

TABLE 8: Ratings & Physical / Electrical Data - Upflow Models

Input		Output		Nominal		Cabinet Width			Air Temp. Rise	
MBH	kW	MBH	kW	CFM	cmm	In.	cm	AFUE	°F	°C
75	22.0	60	17.6	1200	34.0	16 7/8	44.45	80.0	35-65	19.4-36.1
75	22.0	60	17.6	1600	45.3	20	53.34	80.0	30-60	16.7-33.3
100	29.3	80	23.4	1600	45.3	20	53.34	80.0	40-70	22.2-38.9

Input		Max. Outlet Air Temp		Blower		Blower Size		Total Unit	Max Over-current Size (awg) @ 75 ft.	Min. Wire	Operation WGT.	Operation WGT.
MBH	kW	°F	°C	Hp	Amps	In.	cm	amps	protect	one way	LBS	Kg
75	22.0	165	73.9	1/3	6.2	10 x 8	25.4 x 20.3	6.7	15	14	118	53.5
75	22.0	160	71.1	1/2	6.2	10 x 10	25.4 x 25.4	8.5	15	14	129	58.5
100	29.3	170	76.7	1/2	7.0	10 x 10	25.4 x 25.4	8.5	15	14	135	61.2

Wire size and over current protection must comply with the National Electrical Code (NFPA-70-latest edition) and all local codes.
AFUE 80%.

SUPPLY VOLTAGE CONNECTIONS

1. Provide a power supply separate from all other circuits. Install overcurrent protection and disconnect switch per local/national electrical codes. The switch should be close to the unit for convenience in servicing. With the disconnect or fused switch in the OFF position, check all wiring against the unit wiring label. Refer to the wiring diagram in this instruction.
2. Remove the screws retaining the wiring box cover. Route the power wiring through the opening in the unit into the junction box with a conduit connector or other proper connection. In the junction box there will be three wires (a Black Wire, a White Wire and a Green Wire). Connect the power supply as shown on the unit-wiring label on the inside of the blower compartment door or the wiring schematic in this section. The black furnace lead must be connected to the L1 (hot) wire from the power supply. The white furnace lead must be connected to neutral. Connect the green furnace lead (equipment ground) to the power supply ground. An alternate wiring method is to use a field provided 2" (5.1 cm) x 4" (10.2 cm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel. After making the wiring connections replace the wiring box cover and screws. Refer to Figure 12.
3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. Refer to Figure 12.

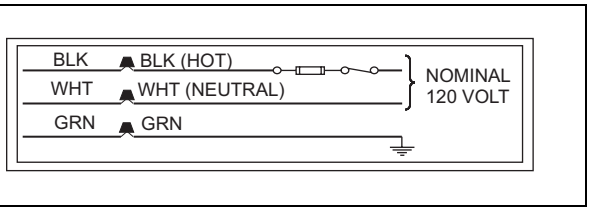


FIGURE 12: Line Wiring Connections

IMPORTANT: The power connection leads and wiring box may be relocated to the left side of the furnace. Remove the screws and cut wire tie holding excess wiring. Reposition on the left side of the furnace and fasten using holes provided.

LOW VOLTAGE CONTROL WIRING CONNECTIONS

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the terminal board on the ignition module, as shown in Figure 13. Electronic thermostats may require the common wire to be connected as shown with the dashed line in Figure 13. Apply strain relief to thermostat wires passing through cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the furnace control board to the yellow and brown wires on the condensing unit (unit outside). Refer to Figure 13.

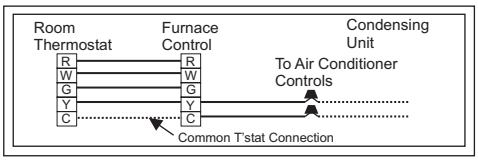


FIGURE 13: Heating and Cooling Thermostat Connections

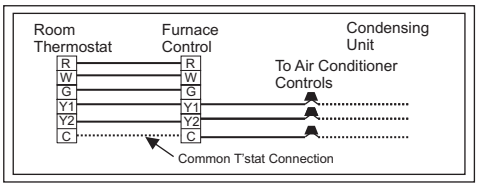


FIGURE 14: Two-Stage Cooling and Single Stage Heating Thermostat Connections

IMPORTANT: Set the heat anticipator in the room thermostat to 0.45 amps. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the set points.

IMPORTANT: Some electronic thermostats do not have adjustable heat anticipators. They may have other type cycle rate adjustments. Follow the thermostat manufacturer's instructions.

The 24-volt, 40 VA transformer is sized for the furnace components only, and should not be connected to power auxiliary devices such as humidifiers, air cleaners, etc. The transformer may provide power for an air conditioning unit contactor.

ACCESSORY CONNECTIONS

The furnace control will allow power-switching control of various accessories. Refer to Figure 15 for connection details.

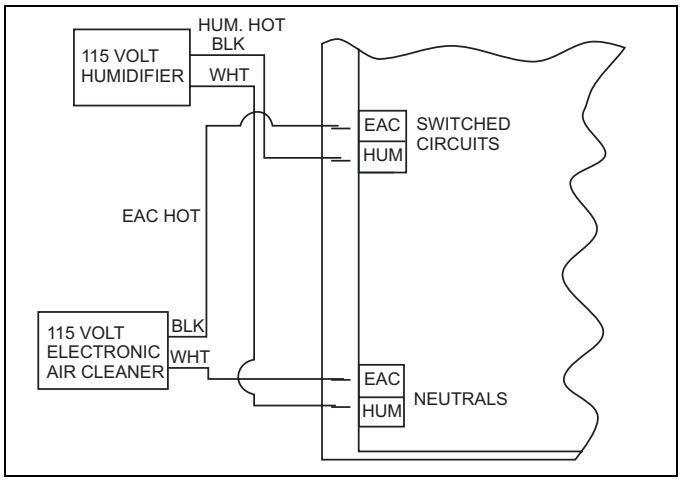


FIGURE 15: Accessory Connections

ELECTRONIC AIR CLEANER CONNECTION

Two 1/4" (0.6 cm) spade terminals (EAC and EAC N) for electronic air cleaner connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during circulating blower operation.

HUMIDIFIER CONNECTION

Two 1/4" (0.6 cm) spade terminals (HUM and HUM N) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during heating system operation.

SECTION VI: TWINNING AND STAGING

NOTE: You can twin two furnaces that have the same integrated control module. Check the part number on the integrated control module. You **cannot twin** two furnaces that have different integrated control module part numbers. If the part numbers of the two integrated control modules are different they may not communicate with each other so they will not work in a twinning application.

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem. When two furnaces are installed using the same duct system, it is very important that the two furnace circulating air blowers operate in unison. If one blower starts before the second blower, the duct system will become pressurized and the blower on the second furnace will turn backwards causing the second furnace to overheat, resulting in damage to the furnace. Twinning is used to make two furnaces operate in tandem, using one duct system, one room thermostat and causing both furnaces to turn on and off simultaneously.

⚠WARNING

Before installing the relay and wiring, disconnect electrical power to both furnaces. Failure to cut power could result in electrical shock or equipment damage.

⚠ CAUTION

The relay must not be installed in any location where it could be exposed to water. If the relay has been exposed to water in any way, it must not be used.

TWINNING DUCT SYSTEM

Twinned furnaces must only be applied on a common duct system. A single air supply plenum must be used for both furnaces and coil(s). Separate plenums and supply ducts systems cannot be utilized. A single return air plenum, common to both furnaces must be used. It is suggested that a return platform be utilized, with bottom air entrance into each furnace. If a side entrance returns system is used, the common return duct must be divided equally so as to supply each furnace with an equal amount of return air.

Both furnaces must be identical models in both heating capacity and CFM capacity. Both furnaces must be operated on the same motor speed tap. See typical application, Figure 16.

If furnace staging is desired with two single stage furnaces on a common duct, where the gas burner on the first furnace operates on W1 and the gas burner on the second furnace operates on W2, then the use of an air-mixing device in the plenum to mix the air from both furnaces is strongly recommended. The mixing device must be installed before any ducts that supply air to occupied spaces. Twinning causes both indoor fans to operate simultaneously. If a mixing device is not used, any ducts that are connected down stream from the furnace that operates on W2, will be supplying cold air in the Heating mode to the occupied spaces unless W2 is energized.

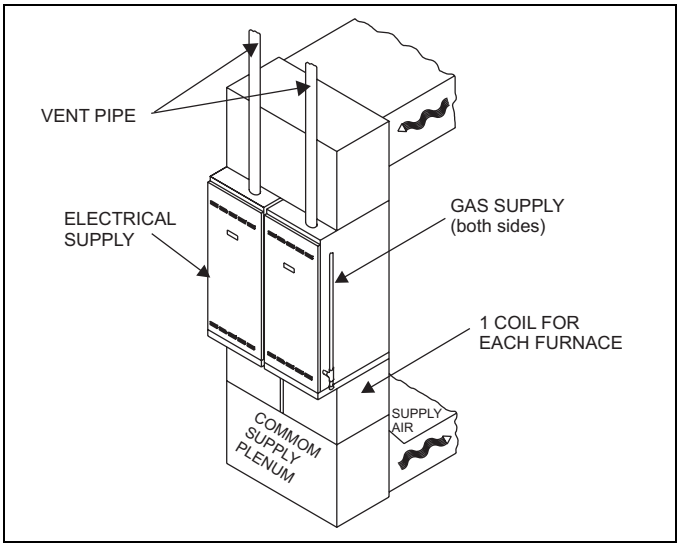


FIGURE 16: Typical Twinned Furnace Application

IMPORTANT: When two furnaces are twinned, typical system total airflow will be approximately 85% of additive individual furnaces, i.e., two 2000 CFM units will yield a total 3400 CFM.

⚠ CAUTION

If a return duct is connected to only one furnace (with a connection between the two furnaces) an imbalance in the airflow will occur and the furnace furthest from the return plenum will overheat.

GAS PIPING

Furnace gas supplies must be provided as specified with these instructions. Since the furnaces are side by side, with no space between, gas supplies must enter on the right and left respectively. All gas piping must be in accordance with the national fuel gas code, ANSI Z223.1, latest edition, and/or all local code or utility requirements.

TWINNING

Single-Wire Twinning

The control in the furnace has the single-wire twinning feature. With this feature, a single wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower.

⚠ CAUTION

The relay must not be installed in any location where it could be exposed to water. If the relay has been exposed to water in any way, it must not be used.

Single-Wire Twinning Instructions

Connect the control wiring as shown in the Figure 17.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1.
2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in the diagram below. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.

Single-Wire Twinning Operation

Heating - On a call for heat (W signal) from the wall thermostat, both furnaces will start the ignition sequence and the burners on both furnaces will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will all shut off and, after the selected blower off delay time, both blowers will shut off at the same time. The twinned controls ensure that both blowers come on and shut off at the same time.

Cooling - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time in cooling speed. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

Continuous Fan - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

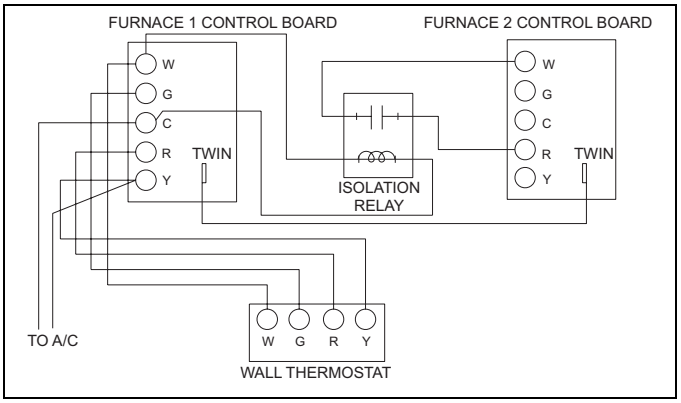


FIGURE 17: Single Stage Twinning Wiring Diagram

STAGING

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem, using one duct system and one room thermostat. This control can also be used along with a two-stage wall thermostat to stage two twinned furnaces, making them operate like a single two-stage furnace. This allows only one furnace to supply heat during times when the heat output from one furnace is sufficient to satisfy the demand. When one duct system is used for two furnaces, it is necessary that the two blowers operate in unison. The twinning function of this board ensures that both blowers turn on and off simultaneously, and operate on the same blower speed. Even when only one furnace is supplying heat, both furnace blowers must run.

Single-Wire Staging

The single-wire twinning feature of this board can also be used for staging of two furnaces. With this feature, a single wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower.

Single-Wire Staging Instructions

Connect the control wiring as shown in the Figure 18.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1. For staging applications, the wire from thermostat W1 is connected to the W connection on the board on Furnace #1. The wire from thermostat W2 is connected to Furnace #2 through a separate relay, as described below.
2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in the diagram below. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.

Single-Wire Staging Operation

Heating - On a call for first-stage heat (W1 signal) from the wall thermostat, Furnace #1 will start the ignition sequence and the burners will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will shut off and, after the selected blower off delay time, both blowers will shut off at the same time. On a call for second stage of heat, the burners of Furnace #2 will also light and both blowers will run. The twinning control ensures that both blowers come on and shut off at the same time.

Cooling - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

Continuous Fan - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

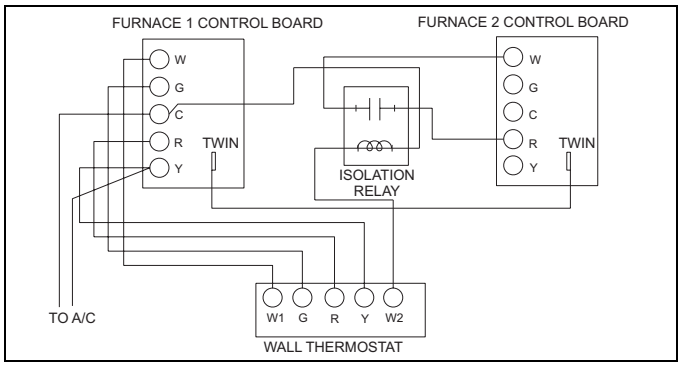


FIGURE 18: Two-Stage Twinning Wiring Diagram

SECTION VII: VENT/COMBUSTION AIR SYSTEM

VENT SAFETY

This Category I furnace is designed for residential application. It may be installed without modification in an equipment room, alcove, attic or any other indoor location where all required clearance to combustibles and other restrictions are met.

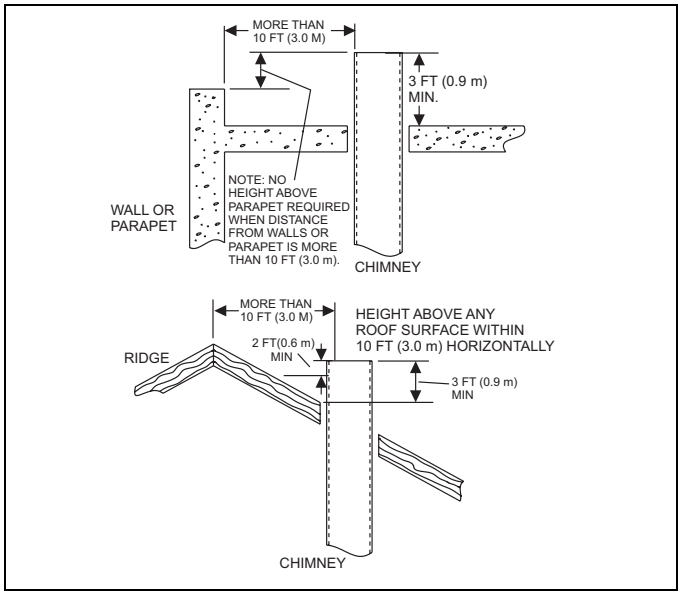

MORE THAN 10 FT (3.0 M)
3 FT (0.9 m) MIN.
WALL OR PARAPET
NOTE: NO HEIGHT ABOVE PARAPET REQUIRED WHEN DISTANCE FROM WALLS OR PARAPET IS MORE THAN 10 FT (3.0 m).
CHIMNEY
MORE THAN 10 FT (3.0 M)
HEIGHT ABOVE ANY ROOF SURFACE WITHIN 10 FT (3.0 m) HORIZONTALLY
2 FT(0.6 m) MIN
RIDGE
3 FT (0.9 m) MIN
CHIMNEY

FIGURE 19: Vent Termination

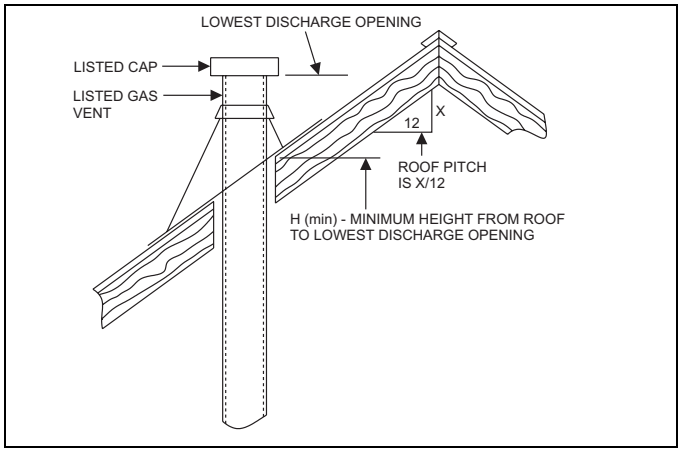


FIGURE 20: Vent Termination

TABLE 9: Roof Pitch

ROOF PITCH	H(min) ft	m
Flat to 6/12	1.0	0.30
6/12 to 7/12	1.25	0.38
Over 7/12 to 8/12	1.5	0.46
Over 8/12 to 9/12	2.0	0.61
Over 9/12 to 10/12	2.5	0.76
Over 10/12 to 11/12	3.25	0.99
Over 11/12 to 12/12	4.0	1.22
Over 12/12 to 14/12	5.0	1.52
Over 14/12 to 16/12	6.0	1.83
Over 16/12 to 18/12	7.0	2.13
Over 18/12 to 20/12	7.5	2.27
Over 20/12 to 21/12	8.0	2.44

CATEGORY 1 - 450 F. MAX. VENT TEMP.

The venting system must be installed in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition), or Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition) or applicable provisions of the local building code and these instructions.

The furnace shall be connected to any type of B, BW or L vent connector, and shall be connected to a factory-built or masonry chimney. **The furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.**

The furnace rating plate lists the maximum vent gas temperature. This temperature must be used to select the appropriate venting materials and clearances.

It is recommended that the appliance is installed in a location where the space temperature is 32 °F (0°C) or higher. If the appliance is installed in a location where the ambient temperature is below 32 °F (0°C), the flue products could condense causing damage to the appliance heat exchanger.

IMPORTANT: The “VENT SYSTEM” must be installed as specified in these instructions for Residential Modular Homes.

This appliance may be common vented with another gas appliance for residential installations as allowed by the codes and standards listed in these instructions.

Modular Homes must be vented with an approved roof jack and may not be common vented with other appliances.

VENTING

Category I venting consists of vertically venting one or more appliances in B-vent or masonry chimney (as allowed), using single wall metal pipe or B-vent connectors. Type B-vent system extends in a general vertical direction and does not contain offsets exceeding 45 degrees. A vent system having not more than one 60 degree offset is permitted.

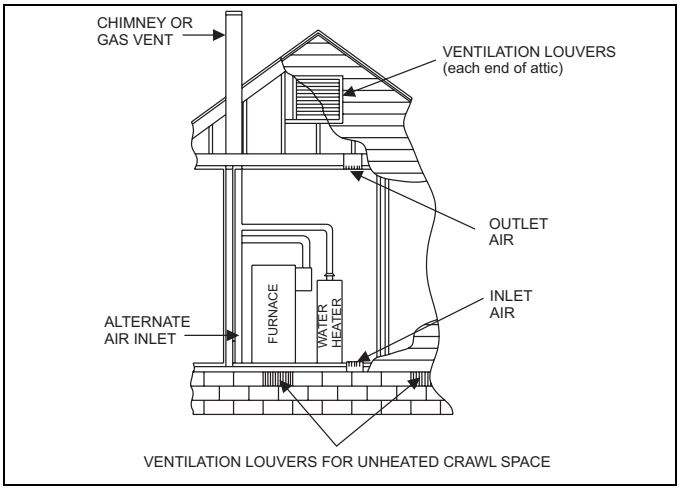


FIGURE 21: Alternate Air Intake, Air Outlet and Chimney Connections

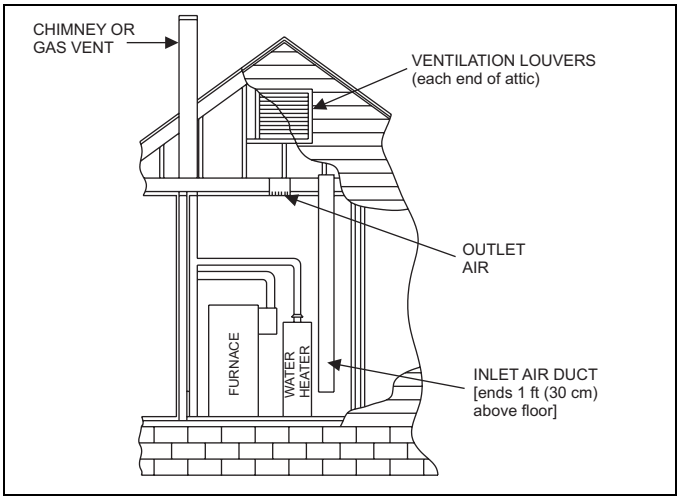


FIGURE 22: Air Inlet, Outlet and Chimney Connections

VENTING INTO AN EXISTING CHIMNEY

For Category I installations, the furnace shall be connected to a factory built chimney or vent complying with a recognized standard, or a masonry or concrete chimney lined with a material acceptable to the authority having jurisdiction. Venting into an unlined masonry chimney or concrete chimney is prohibited.

Whenever possible, B-1 metal pipe should be used for venting. Where use of an existing chimney is unavoidable, the following rules must be followed:

1. The masonry chimney must be built and installed in accordance with nationally recognized building codes or standards and must be lined with approved fire clay tile flue liners or other approved liner material that will resist corrosion, softening, or cracking from flue gases. **THIS FURNACE IS NOT TO BE VENTED INTO AN UNLINED MASONRY CHIMNEY.**
2. This furnace must be vented into a fire clay tile lined masonry chimney only if a source of dilution air is provided, such as by common venting with a draft hood equipped water heater. If no source of dilution air is available, Type B vent must be used, or masonry chimney vent kit 1CK0603 or 1CK0604 must be used. Refer to the instructions with the kit to properly apply these masonry chimney kits.
3. The chimney must extend at least three feet above the highest point where it passes through a roof of a building and at least two feet higher than any portion of the building with a horizontal distance of ten feet.
4. The chimney must extend at least five feet above the highest equipment draft hood or flue collar.

HORIZONTAL SIDEWALL VENTING

For applications where vertical venting is not possible, the only approved method of horizontal venting is the use of an auxiliary power vent. Approved power venters are Fields Controls Model SWG-4Y or Tjernlund Model GPAK-JT. Follow all application and installation details provided by the manufacturer of the power vent. Refer to Figures 23 and 24 for typical installation views.

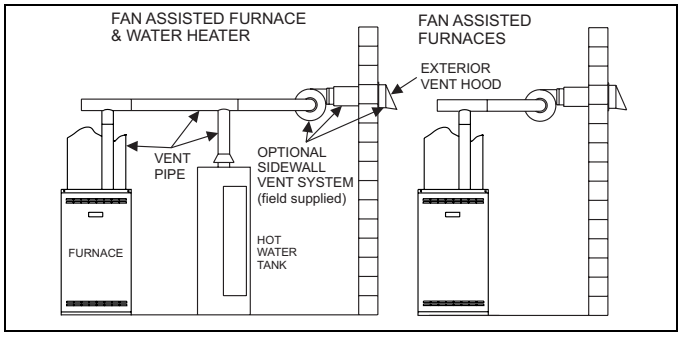


FIGURE 23: Typical Sidewall Vent Application

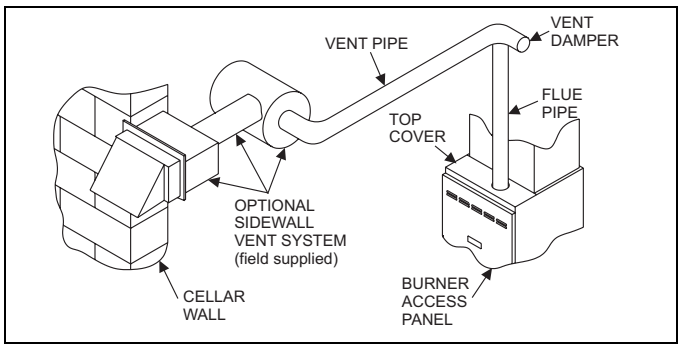


FIGURE 24: Typical Sidewall Vent and Termination Configuration

VENT PIPING ASSEMBLY

The final assembly procedure for the vent piping is as follows:

1. Cut piping to the proper length beginning at the furnace.
2. Deburr the piping inside and outside.
3. Dry-fit the vent piping assembly from the furnace to the termination checking for proper fit support and slope. Piping should be supported with pipe hangers to prevent sagging. The maximum spacing between hangers is 4 feet (1.22 m).
4. Assemble the vent piping from the furnace to the termination securing the pipe connections with screws.

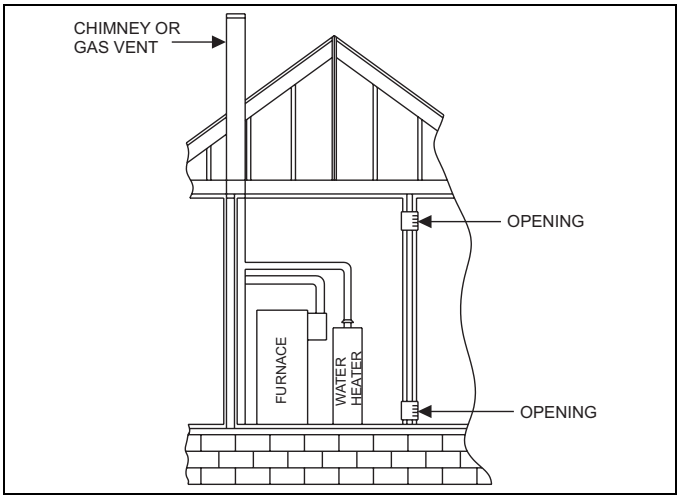


FIGURE 25: Typical Chimney Connections

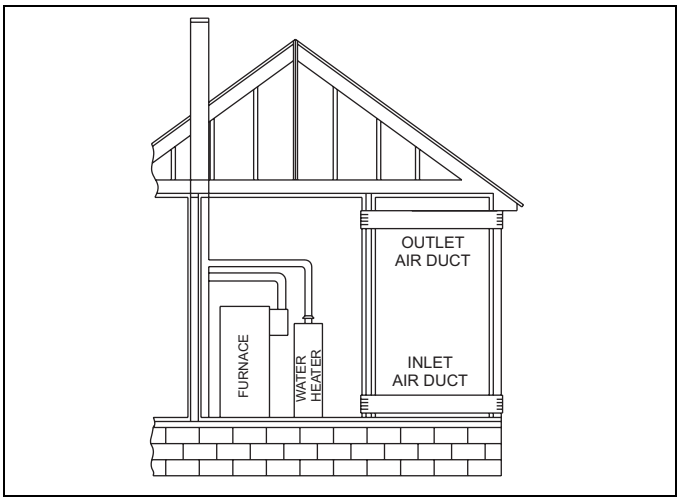


FIGURE 26: Horizontal Air Inlet, Outlet and Chimney Connections

VENT CLEARANCES

IMPORTANT: The vent must be installed with the following minimum clearances as shown in Figure 27 and must comply with state, regional, and local codes and requirements.

TABLE 10: Horizontal Sidewall Venting Clearances

						Horizontal Vent Length Ft. (m) with 4 Elbows					
Heating	Heating	Heating	Heating	Furnace	Furnace	Pipe Size		Min. Vent Length		Max. Vent Length	
Input	Input	Output	Output	Airflow	Airflow	Inches	cm				
BTU/H	kW	BTU/H	kW	CFM	cm/m			Feet	meters	Feet	meters
75,000	22.0	60,000	17.6	1200	33.98	4	10.16	4.5	1.37	34.5	10.82
75,000	22.0	60,000	17.6	1600	45.31	4	10.16	4.5	1.37	34.5	10.82
100,000	29.5	80,000	23.9	1600	45.31	4	10.16	4.5	1.37	34.5	10.82

VENT CLEARANCES

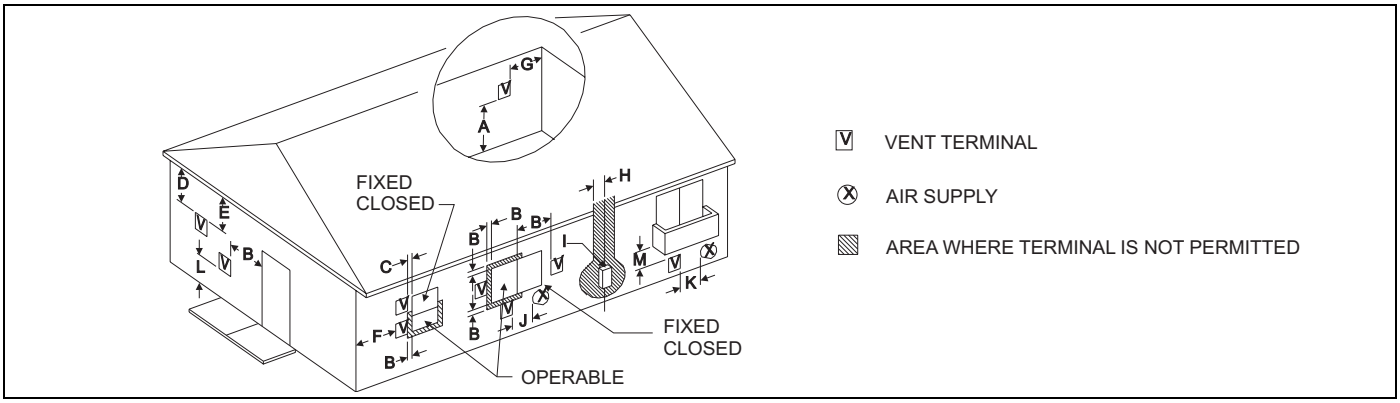


FIGURE 27: Home Layout

	Canadian Installations[1]	US Installation[2]
A. Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm)	12 inches (30 cm)
B. Clearance to window or door that may be opened	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and ≤ 100,000 Btuh (30kW), 36 inches (91 cm) for appliances > 100,000 Btuh (30kW)	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 9 inches (23 cm) for appliances > 10,000 Btuh (3kW) and ≤ 50,000 Btuh (15kW), 12 inches (30 cm) for appliances > 50,000 Btuh (30kW)
C. Clearance to permanently closed window	"	"
D. Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	"	"
E. Clearance to unventilated soffit	"	"
F. Clearance to outside corner	"	"
G. Clearance to inside corner	"	"
H. Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.5 m) above the meter/regulator assembly	"
I. Clearance to service regulator vent outlet	3 feet (91 cm)	"
J. Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3kW) and ≤ 100,000 Btuh (30kW), 36 inches (91 cm) for appliances > 100,000 Btuh (30kW)	6 inches (15 cm) for applications ≤ 10,000 Btuh (3kW), 9 inches (23 cm) for appliances > 10,000 Btuh (3kW) and ≤ 50,000 Btuh (15kW), 12 inches (30 cm) for appliances > 50,000 Btuh (30kW)
K. Clearance to a mechanical supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 cm) horizontally
L. Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m) †	"
M. Clearance under veranda, porch, deck, or balcony	12 inches (30 cm) ‡	"
Dryer Vent	3 ft. (91.44 cm)	3 ft. (91.44 cm)
Plumbing Vent Stack	3 ft. (91.44 cm)	3 ft. (91.44 cm)
Gas Appliance Vent Terminal	3 ft. (91.44 cm) *	3 ft. (91.44 cm) *
Vent Termination from any Building Surface	12" (30.4 cm)	12" (30.4 cm)
Above Any Grade Level	12" (30.4 cm)	12" (30.4 cm)
Above anticipated snow depth	12" (30.4 cm)	12" (30.4 cm)
Any forced air inlet to the building.	10 ft. (304.8 cm)	10 ft. (304.8 cm)
The vent shall extend above the highest point where it passes through the roof, not less than	18" (46 cm)	18" (46 cm)
Any obstruction within a horizontal distance	Not less than 18" (46 cm)	Not less than 18" (46 cm)

1. In accordance with the current CSA B149.1-00, Natural Gas and Propane Installation Code.
2. In accordance with the current ANSI Z223.1 / NFPA 54, National Gas Code.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor. For clearance not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1-00.

Clearance in accordance with local installation codes and the requirements of the gas supplier and the manufacturer's Installation Manual.

Any fresh air or make up inlet for dryer or furnace area is considered to be forced air inlet.

Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

A terminus of a vent shall be either:

Fitted with a cap in accordance with the vent manufacturer's installation instructions, or In accordance with the installation instructions for a special venting system.

* Does not apply to multiple installations of this furnace model. Refer to "VENTING MULTIPLE UNITS" in this section of these instructions.

IMPORTANT: Consideration must be given for degradation of building materials by flue gases. Sidewall termination may require sealing or shielding of building surfaces with a corrosion resistant material to protect against combustion product corrosion. Consideration must be given to wind direction in order to prevent flue products and/or condensate from being blown against the building surfaces. If a metal shield is used it must be a stainless steel material at a minimum dimension of 20 inches. It is recommended that a retaining type collar be used that is attached to the building surface to prevent movement of the vent pipe.

Responsibility for the provision of proper adequate venting and air supply for application shall rest with the installer.

Vent shall extend high enough above building, or a neighboring obstruction, so that wind from any direction will not create a positive pressure in the vicinity of the vent.

HORIZONTAL VENT APPLICATIONS AND TERMINATION

When selecting the location for a horizontal combustion air / vent termination, the following should be considered:

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where flue products will not damage plants or shrubs or air conditioning equipment.
3. Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
5. Termination should be positioned where vent vapors are not objectionable.
6. Horizontal portions of the vent system must slope upwards and be supported to prevent sagging. The vent system may be supported by the use of clamps or hangers secured to a permanent part of the structure every 4 ft. (1.22 m).

FAN-ASSISTED COMBUSTION SYSTEM

An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger.

Ambient Combustion Air Supply

This type installation will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided. For upflow models combustion air is brought into the furnace through the unit top panel opening.

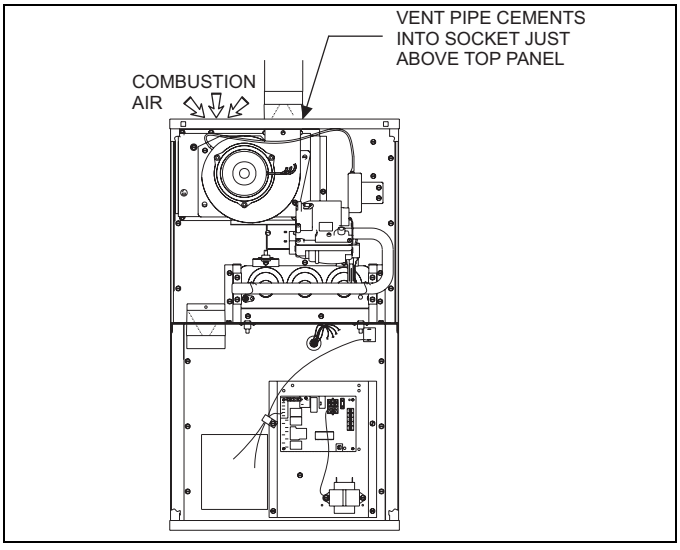


FIGURE 28: Combustion Airflow Path Through The Furnace Casing to the Burner Box

⚠WARNING

This type of installation requires that the supply air to the appliance(s) be of a sufficient amount to support all of the appliance(s) in the area. Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances. A venting problem or a lack of supply air will result in a hazardous condition, which can cause the appliance to soot and generate dangerous levels of CARBON MONOXIDE, which can lead to serious injury, property damage and / or death.

An **unconfined space** is not less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are furnished with doors.

A **confined space** is an area with less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Combustion Air Source From Outdoors

The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, refer to Table 11, to estimate free area.

TABLE 11: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20-25%* Metal 60-70% *
Screens+	1/4" (0.635 cm) mesh or larger 100%

* Do not use less than 1/4" (0.635 cm) mesh

\+ Free area or louvers and grille varies widely; the installer should follow louver or grille manufacturer's instructions.

Dampers, Louvers and Grilles (Canada Only)

1. The free area of a supply air opening shall be calculated by subtracting the blockage area of all fixed louvers grilles or screens from the gross area of the opening.
2. Apertures in a fixed louver, a grille, or screen shall have no dimension smaller than 0.25" (0.635 cm).
3. A manually operated damper or manually adjustable louvers are not permitted for use.
4. A automatically operated damper or automatically adjustable louvers shall be interlocked so that the main burner cannot operate unless either the damper or the louver is in the fully open position.

TABLE 12: Free Area

BTUH Input Rating	Minimum Free Area Required for Each Opening		
	Horizontal Duct (2,000 BTUH)	Vertical Duct or Opening to Outside (4,000 BTUH)	Round Duct (4,000 BTUH)
75,000	37.5 in^2 (193 cm^2)	18.7 in^2 (97 cm^2)	5" (13 cm)
100,000	50 in^2 (322 cm^2)	25 in^2 (161 cm^2)	6" (15 cm)
EXAMPLE: Determining Free Area. Appliance 1Appliance 2Total Input 100,000 + 30,000 = (130,000 ÷ 4,000) = 32.5 Sq. In. Vertical Appliance 1Appliance 2Total Input 100,000 + 30,000 = (130,000 ÷ 2,000) = 65 Sq. In. Horizontal			

TABLE 13: Unconfined Space Minimum Area in Square Feet

BTUH Input Rating	Minimum Free Area Required for Each Opening
75,000	469 (43.57 m^2)
100,000	625 (58.06 m^2)
EXAMPLE: Square feet is based on 8 foot ceilings. $\frac{28{,}000 \text{ BTUH}}{1{,}000}$ X 50 Cubic Ft. = $\frac{1{,}400}{8\text{' Ceiling Height}}$ = 175 Sq. Ft.	

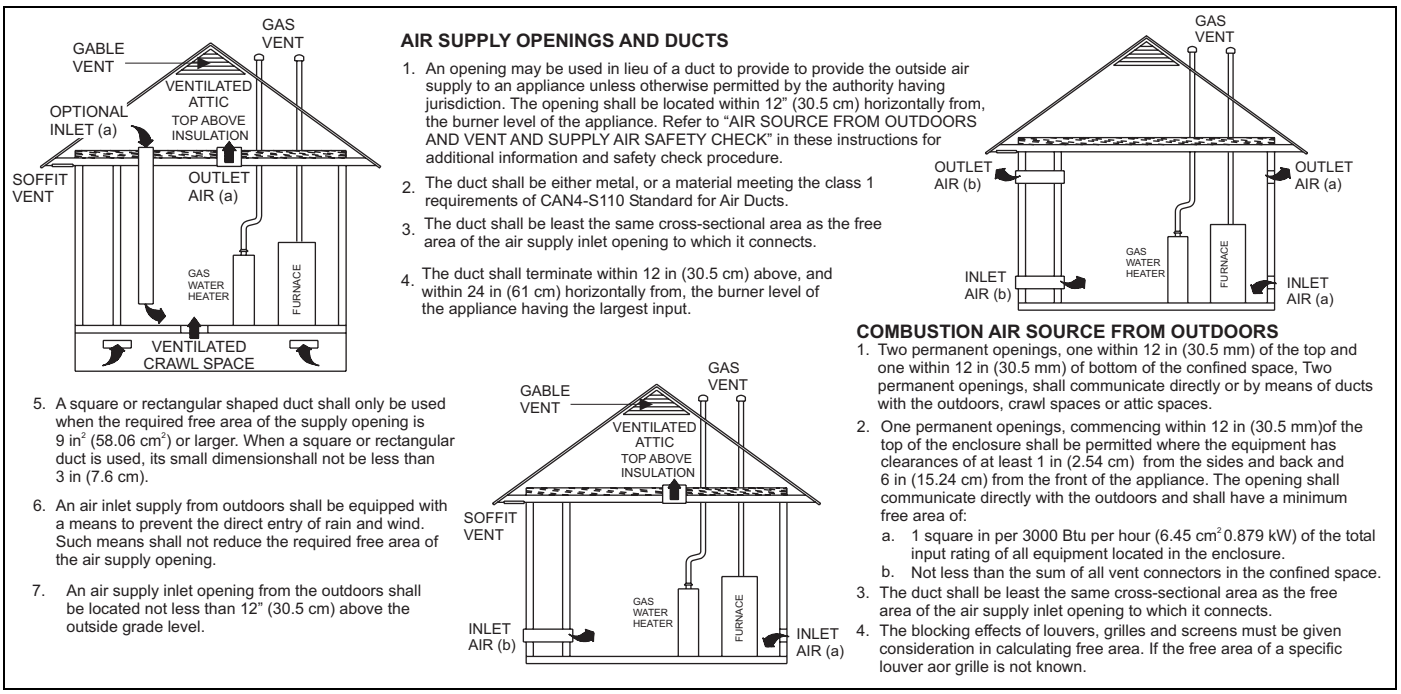

GABLE VENT
GAS VENT
VENTILATED ATTIC
TOP ABOVE INSULATION
OPTIONAL INLET (a)
SOFFIT VENT
OUTLET AIR (a)
GAS WATER HEATER
FURNACE
VENTILATED CRAWL SPACE
AIR SUPPLY OPENINGS AND DUCTS
1. An opening may be used in lieu of a duct to provide to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening shall be located within 12" (30.5 cm) horizontally from, the burner level of the appliance. Refer to "AIR SOURCE FROM OUTDOORS AND VENT AND SUPPLY AIR SAFETY CHECK" in these instructions for additional information and safety check procedure.
2. The duct shall be either metal, or a material meeting the class 1 requirements of CAN4-S110 Standard for Air Ducts.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The duct shall terminate within 12 in (30.5 cm) above, and within 24 in (61 cm) horizontally from, the burner level of the appliance having the largest input.
5. A square or rectangular shaped duct shall only be used when the required free area of the supply opening is 9 in² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimensionshall not be less than 3 in (7.6 cm).
6. An air inlet supply from outdoors shall be equipped with a means to prevent the direct entry of rain and wind. Such means shall not reduce the required free area of the air supply opening.
7. An air supply inlet opening from the outdoors shall be located not less than 12" (30.5 cm) above the outside grade level.
GAS VENT
OUTLET AIR (b)
OUTLET AIR (a)
INLET AIR (b)
INLET AIR (a)
GAS WATER HEATER
FURNACE
COMBUSTION AIR SOURCE FROM OUTDOORS
1. Two permanent openings, one within 12 in (30.5 mm) of the top and one within 12 in (30.5 mm) of bottom of the confined space, Two permanent openings, shall communicate directly or by means of ducts with the outdoors, crawl spaces or attic spaces.
2. One permanent openings, commencing within 12 in (30.5 mm)of the top of the enclosure shall be permitted where the equipment has clearances of at least 1 in (2.54 cm) from the sides and back and 6 in (15.24 cm) from the front of the appliance. The opening shall communicate directly with the outdoors and shall have a minimum free area of:
a. 1 square in per 3000 Btu per hour (6.45 cm² 0.879 kW) of the total input rating of all equipment located in the enclosure.
b. Not less than the sum of all vent connectors in the confined space.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver aor grille is not known.

FIGURE 29: Outside and Ambient Combustion Air

⚠WARNING

When a Category I furnace is removed or replaced, the original venting system may no longer be correctly sized to properly vent the attached appliances.

An improperly sized vent system can cause CARBON MONOXIDE to spill into the living space causing personal injury, and or death.

Ventilated Combustion Air

The ventilated attic space or a crawl space from which the combustion air is taken must comply with the requirements specified in "AIR SOURCE FROM OUTDOORS" in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type installation requires a pipe that extends from the furnace vent connection (top right of unit) to the exterior of the building. Follow all notes, procedures and required materials in the COMBUSTION AIR SUPPLY section in these instructions when installing the unit and into a ventilated attic space or crawl space. DO NOT terminate vent pipe in an Attic or Crawl Space.

Vent and Supply (Outside) Air Safety Check Procedure

For Category I furnaces, vent installations shall be in accordance with Parts 7 and 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, and or Section 7 and Appendix B of the CSA B149.1, Natural Gas and Propane Installation Codes, the local building codes, furnace and vent manufacture's instructions.

Multistory or common venting systems are permitted and must be installed in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and / or the CSA B149.1, Natural Gas and Propane Installation Codes, local codes, and the manufacture's instructions.

Vent connectors serving Category I furnaces shall not be connected into any portion of mechanical draft systems operating under positive pressure.

Horizontal portions of the venting system shall be supported to prevent sagging using hangers or perforated straps and must slope upwards not less than 1/4" per foot (0.635 cm/m) from the furnace to the vent terminal.

It is recommended that you follow the venting safety procedure below. This procedure is designed to detect an inadequate ventilation system that can cause the appliances in the area to operate improperly causing unsafe levels of Carbon Monoxide or an unsafe condition to occur.

⚠WARNING

CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon monoxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows and all doors.
3. Turn on clothes dryers and TURN ON any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Open the fireplace dampers. Do not operate a summer exhaust fan.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test each appliance (such as a water heater) equipped with a draft hood for spillage (down-draft or no draft) at the draft hood relief opening after 5 minutes of main burner operation. Appliances that do not have draft hoods need to be checked at the vent pipe as close to the appliance as possible. Use a combustion analyzer to check the CO2 and CO levels of each appliance. Use a draft gauge to check for a downdraft or inadequate draft condition.
6. After it has been determined that each appliance properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their normal condition.
7. If improper venting is observed during any of the above tests, a problem exists with either the venting system or the appliance does not have enough combustion air (Supply Air from outside) to complete combustion. This condition must be corrected before the appliance can function safely.

NOTE: An unsafe condition exists when the CO reading at the furnace vent exceeds 40 ppm and the draft reading is not in excess of - 0.1 in. W.C. (-25 kPa) with all of the appliance(s) operating at the same time.

8. Any corrections to the venting system and / or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1-00 Natural Gas and Propane Installation Code (latest editions). If the vent system must be resized, follow the appropriate tables in Appendix G of the above codes or for this appliance.

SECTION VIII: SAFETY CONTROLS

CONTROL CIRCUIT FUSE

A 3-amp fuse is provided on the control circuit board to protect the 24-volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located on the control board.

BLOWER DOOR SAFETY SWITCH

This unit is equipped with an electrical interlock switch mounted in the blower compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.

Electrical supply to this unit is dependent upon the panel that covers the blower compartment being in place and properly positioned.

⚠ CAUTION

Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. Do not rely upon the interlock switch as a main power disconnect.

Blower and burner must never be operated without the blower panel in place.

ROLLOUT SWITCH CONTROLS

These controls are mounted on the burner box assembly. If the temperature in the burner box exceeds its set point, the ignition control and the gas valve are de-energized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. These are manual reset controls that must be reset before operation can continue.

PRESSURE SWITCHES

This furnace is supplied with a pressure switch, which monitors the flow through the combustion air/vent piping system. This switch de-energizes the ignition control module and the gas valve if any of the following conditions are present. Refer to Figure 30 for tubing connections.

1. Blockage of combustion air piping or terminal.
2. Blockage of vent piping or terminal.
3. Failure of combustion air blower motor.

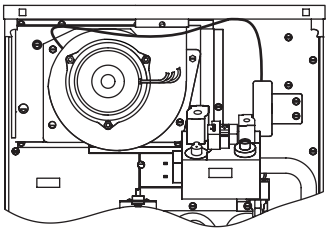


FIGURE 30: Pressure Switch Tubing Routing

LIMIT CONTROLS

There is high temperature limit control located on the furnace vestibule panel near the gas valve. This is an automatic reset control that provides over temperature protection due to reduced airflow, that may be caused by a dirty filter, or if the indoor fan motor should fail. The control module will lockout if the limit trips 3 consecutive times. Control will reset and try ignition again after 1 hour.

SECTION IX: START-UP AND ADJUSTMENTS

The initial start-up of the furnace requires the following additional procedures:

IMPORTANT: All electrical connections made in the field and in the factory should be checked for proper tightness.

When the gas supply is initially connected to the furnace, the gas piping may be full of air. In order to purge this air, it is recommended that the ground union be loosened until the odor of gas is detected. When gas is detected, immediately retighten the union and check for leaks. Allow five minutes for any gas to dissipate before continuing with the start-up procedure. Be sure proper ventilation is available to dilute and carry away any vented gas.

TOOLS AND INFORMATION THAT WILL BE REQUIRED IN ORDER TO PROPERLY PERFORM THE FURNACE STARTUP PROCEDURE.

1. Call the local gas supplier to obtain heating value of the natural gas. If you cannot obtain the heating valve of the gas from the gas supplier, you may use a default value of 1030 BTU/SCF (38.8 MJ / m^3) for natural gas.
2. You will need a thermometer or portable digital thermometer to read the supply and return air temperatures.
3. You will need a U-tube manometer or digital equipment that has the ability to read pressures between 0 – 15” in.w.c (0 - 3.73 kPa) in order to measure the gas line and the manifold pressures.
4. You will need a 3/32” Allen wrench for the pressure port plugs in the gas valve.
5. You will need 2 pieces of 1/8” (0.3 cm) ID flexible tubing that is 12” (30 cm) in length, 2 – pieces of 1/8” (0.3 cm) tubing that are 4” (10.0 cm) in length, a 1/8” (0.3 cm) tee and a 1/8” (0.3 cm) adapter to connect the U-tube manometer or the digital pressure measuring equipment to the gas valve pressure ports.

There is an accessory kit (1PK0601) available from Source 1, which has the following items:

- 1 - 12” (30 cm) length x 1/8” (0.3 cm) diameter tubing
- 2 – pieces of 4” (10 cm) length x 1/8” (0.3 cm) diameter tubing
- 1 - 5/16” (0.8 cm) tee
- 1 – 5/16” (0.8 cm) x 1/8” (0.3 cm) reducing coupling
- 1 – 1/8” (0.3 cm) adapter

There is a accessory kit (1PK0602) available from Source 1, which has the following items:

- 12” (30 cm) length x 1/8” (0.3 cm) diameter tubing
- 2 – pieces of 4” (10 cm) length x 1/8” (0.3 cm) diameter tubing
- 1 - 5/16” (0.8 cm) tee
- 1 – 5/16” (0.8 cm) x 1/8” (0.3 cm) reducing coupling
- 1 – 1/8” (0.3 cm) adapter
- 1 - Dwyer – Manometer

These items are required in order to properly perform the required startup procedure.

IGNITION SYSTEM SEQUENCE

1. Turn the gas supply ON at external valve and main gas valve.
2. Set the thermostat above room temperature to call for heat.
3. System start-up will occur as follows:
   a. The induced draft blower motor will start and come up to speed. Shortly after inducer start-up, the hot surface igniter will glow for about 17 seconds.
   b. After this warm up, the ignition module will energize (open) the main gas valve.
   c. After flame is established, the supply air blower will start in about 30 seconds.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

IMPORTANT: Burner ignition may not be satisfactory on first startup due to residual air in the gas line or until gas manifold pressure is adjusted. The ignition control will make 3 attempts to light before locking out.

With furnace in operation, check all of the pipe joints, gas valve connections and manual valve connections for leakage using an approved gas detector, a non-corrosive leak detection fluid, or other leak detection methods. Take appropriate steps to stop any leak. If a leak persists, replace the component.

The furnace and its equipment shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSI (3.45 kPa).

The furnace must be isolated from the gas supply piping system by closing the equipment shutoff valve during any pressure testing of the gas supply piping system.

CALCULATING THE FURNACE INPUT (NATURAL GAS)

NOTE: Burner orifices are sized to provide proper input rate using natural gas with a heating value of 1030 BTU/Ft^3. If the heating value of your gas is significantly different, it may be necessary to replace the orifices.

1. Turn off all other gas appliances connected to the gas meter.
2. At the gas meter, measure the time (with a stop watch) it takes to use 2 cubic ft. (0.0566 m^3.) of gas.
3. Calculate the furnace input by using one of the following equations.

In the USA use the following formula to calculate the furnace input.

For natural gas multiply the heat content of the gas BTU/SCF (or Default 1030 BTU/SCF, times 2 cubic ft. of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 2 cubic ft. of gas from the gas meter.

For propane (LP) gas multiply the heat content of the gas BTU/SCF (or Default 2500 BTU/SCF, times 1 cubic ft. of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time (In seconds) it took to measure 1 cubic ft. of gas from the gas meter.

The formula for US input calculation using a cubic foot gas meter:

$\frac{BTU/f^3 \times 2 \text{ cu.ft.} \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	BTUH/H	$\frac{BTU/f^3 \times 1 \text{ cu.ft.} \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	BTUH/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{1030 \times 2 \times 0.960 \times 3600}{90.5}$ Natural Gas BTU/SCF 1030	=	79,997.38	**PROPANE (LP) GAS INPUT CALCULATION** EXAMPLE: $\frac{2500 \times 1 \times 0.960 \times 3600}{108}$ Propane Gas BTU/SCF 2500	=	80,000.00

In Canada you will use the following formula to calculate the furnace input if you are using a cubic foot gas meter.

For Natural Gas multiply the Heat content of the gas MJ/m^3 (or Default 39.2), times 2 cu. ft. of gas x 0.02831 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 2 cu.ft. of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m^3 (or Default 93.14), times 1 cu. ft. of gas x 0.02831 to convert from cubic feet to cubic meters measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 1 cu.ft. of gas from the gas meter.

The formula for metric input calculation using a cubic foot gas meter:

$\frac{MJ/m^3 \times (2 \text{ cu.ft.} \times \text{Conv}) \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTUH/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{39.2 \times 2 \times 0.960 \times 3600}{90.5}$ Natural Gas BTU/SCF 1030 = 39.2 MJ/m^3	=	84.76	x	0.2777	=	23.54	x	3412.14	=	80,312.62
PROPANE (LP) GAS INPUT CALCULATION EXAMPLE: $\frac{93.15 \times 1 \times 0.960 \times 3600}{108}$ Propane Gas BTU/SCF 2500+93.15 MJ/m^3	=	84.41	x	0.2777	=	23.45	x	3412.14	=	80,000.00

In Canada use the following formula to calculate the furnace input if you are using a gas meter that measures cubic meters.

For Natural Gas multiply the Heat content of the gas MJ/m^3 (or Default 39.2), times 0.0566 m^3 of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.0566 m^3 of gas from the gas meter.

For Propane (LP) Gas multiply the Heat content of the gas MJ/m^3 (or Default 93.14), times 0.00283 m^3 of gas measured at the gas meter, times a barometric pressure and temperature correction factor of 0.960; times 3600, then divided by the time it took to measure 0.0283 cm of gas from the gas meter.

The formula for metric input calculation using a cubic foot gas meter:

$\frac{MJ/m^3 \times (2 \text{ cu.ft.} \times \text{Conv}) \times 0.960 \times 3600}{\text{Seconds it took to measure the 2 cu.ft. of gas}}$	=	MJ/H	x	0.2777	=	kW	x	3412.14	=	BTUH/H
NATURAL GAS INPUT CALCULATION EXAMPLE: $\frac{39.2 \times 2 \times 0.960 \times 3600}{90.5}$ Natural Gas BTU/SCF 1030 = 39.2 MJ/m^3	=	84.76	x	0.2777	=	23.54	x	3412.14	=	80,312.62
PROPANE (LP) GAS INPUT CALCULATION EXAMPLE: $\frac{93.15 \times 1 \times 0.960 \times 3600}{108}$ Propane Gas BTU/SCF 2500+93.15 MJ/m^3	=	84.41	x	0.2777	=	23.45	x	3412.14	=	80,000.00

DO NOT ADJUST the manifold pressure regulator if the actual input is equal to or within 8% less than the furnace input specified on the rating plate or if the furnace rise is above the specified rise range on the rating plate.

If the actual input is significantly higher than the furnace input specified on the rating plate then replace the gas orifice spuds with the gas orifice spuds of the proper size for the type of gas you are using.

For altitudes above 2,000 ft. (610 m) the furnace input MUST BE DERATED. Refer to the GAS CONVERSION FOR PROPANE (LP) AND HIGH ALTITUDES IN SECTION IV for information on high altitude conversions.

⚠ CAUTION

Be sure to relight any gas appliances that were turned off at the start of this input check.

TABLE 14: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5” W.C. (1.12 kPa)	8.0” W.C. (1.99 kPa)
Maximum	10.5” W.C. (2.61 kPa)	13.0” (3.24 kPa) W.C.

IMPORTANT: The inlet gas pressure operating range table specifies what the minimum and maximum gas line pressures must be for the furnace to operate safely. The gas line pressure **MUST BE** a minimum of

- 7” W.C. (1.74 kPA) for Natural Gas
- 11” W.C. (2.74 kPA) for Propane (LP) Gas

in order to obtain the BTU input specified on the rating plate and in these instructions.

ADJUSTMENT OF MANIFOLD GAS PRESSURE

Manifold gas pressure may be measured at the gas valve.

Turn gas off at the ball valve or gas cock on gas supply line before the gas valve. Find the pressure ports on the gas valve marked OUT P and IN P.

1. The manifold pressure must be taken at the port marked OUT P.
2. The gas line pressure must be taken at the port marked IN P.
3. Using a 3/32” Allen wrench, loosen the setscrew by turning it 1 turn counter clockwise. DO NOT REMOVE THE SET SCREW FROM THE PRESSURE PORT.
4. Use the 4” (10.2 cm) piece of 1/8” (0.3 cm) tubing to connect the positive side of the manometer to the gas valve manifold pressure port. Refer to Figure 32 for connection details.

IMPORTANT: The cap for the pressure regulator must be removed entirely to gain access to the adjustment screw. Loosening or tightening the cap does not adjust the flow of gas.

5. Refer to Figure 31 for location of pressure regulator adjustment cap and adjustment screw on main gas valve.
6. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.
7. Adjust manifold pressure by adjusting gas valve regulator screw for the appropriate gas per the following:

TABLE 15: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas	3.5" w.c. (0.87 kPa)
Propane (LP) Gas	10.0" w.c. (2.488 kPa)

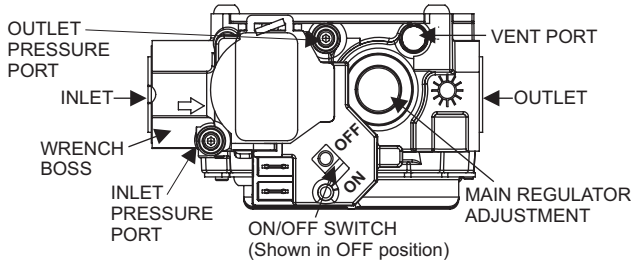


FIGURE 31: Gas Valve

IMPORTANT: If gas valve regulator is turned in (clockwise), manifold pressure is increased. If screw is turned out (counterclockwise), manifold pressure will decrease.

8. After the manifold pressure has been adjusted, re-calculate the furnace input to make sure you have not exceeded the specified input on the rating plate. Refer to “CALCULATING THE FURNACE INPUT (NATURAL GAS)”.
9. Once the correct BTU (kW) input has been established, turn the gas valve to OFF and turn the electrical supply switch to OFF; then remove the flexible tubing and fittings from the gas valve pressure tap and tighten the pressure tap plug using the 3/32” Allen wrench.
10. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved gas detector, a non-corrosive leak detection fluid, or other leak detection methods.

⚠ WARNING

The manifold pressure must be checked with the screw-off cap for the gas valve pressure regulator in place. If not, the manifold pressure setting could result in an over-fire condition. A high manifold pressure will cause an over-fire condition, which could cause premature heat exchanger failure. If the manifold pressure is too low, sooting and eventual clogging of the heat exchanger could occur. Be sure that gas valve regulator cap is in place and burner box to gas valve pressure reference hose is connected.

MAINFOLD PRESSURE “U” TUBE CONNECTION

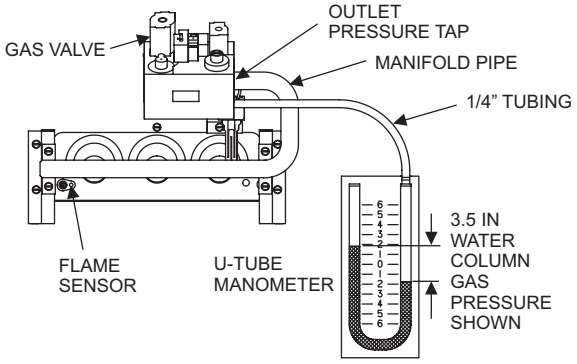


FIGURE 32: Reading Gas Pressure

ADJUSTMENT OF TEMPERATURE RISE

⚠ DANGER

The temperature rise, or temperature difference between the return air and the supply (heated) air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 8 “ELECTRICAL AND PERFORMANCE DATA”.

*The supply air temperature cannot exceed the **“Maximum Supply Air Temperature”** specified in these instructions and on the furnace rating plate. Under NO circumstances can the furnace be allowed to operate above the Maximum Supply Air Temperature. Operating the furnace above the Maximum Supply Air Temperature will cause premature heat exchanger failure, high levels of Carbon Monoxide, a fire hazard, personal injury, property damage, and/or death.*

The temperature rise, or temperature difference between the return air and the heated supply air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations as shown in Table 8.

After about 15 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts, about six feet (1.83 m) from the furnace where they will not be affected by radiant heat. Increase the blower speed to decrease the temperature rise; decrease the blower speed to increase the rise.

All direct-drive blowers have multi-speed motors. The blower motor speed taps are located in the control box in the blower compartment. Refer to Figure 33, and the unit wiring label to change the blower speed. To use the same speed tap for heating and cooling, the heat terminal and cool terminal must be connected using a jumper wire and connected to the desired motor lead. Place all unused motor leads on Park terminals. Two are provided.

⚠ CAUTION

Do not energize more than one motor speed at a time or damage to the motor will result.

ADJUSTMENT OF FAN CONTROL SETTINGS

This furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 seconds. The fan off delay has 4 settings (60, 90, 120 and 180 seconds). The fan off delay is factory set to 120 seconds. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan-off timing may be adjusted by positioning the jumper on two of the four pins as shown in Figure 33.

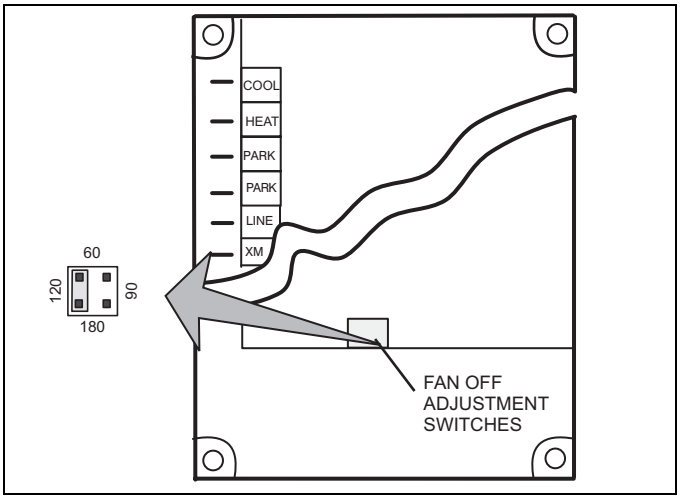


FIGURE 33: Typical Heat/Cool Speed Tap Connections

FILTER PERFORMANCE

The airflow capacity data published in Table 17 represents blower performance WITHOUT filters. To determine the approximate blower performance of the system, apply the filter drop value for the filter being used or select an appropriate value from the Table 16.

The filter pressure drop values in Table 16 are typical values for the type of filter listed and should only be used as a guideline. Actual pressure drop ratings for each filter type vary between filter manufacturers.

TABLE 16: Filter Performance - Pressure Drop Inches W.C. and (kPa)

Airflow Range		Minimum Opening Size				Filter Type											
						Disposable				Hogs Hair*				Pleated			
		1 Opening		2 Openings		1 Opening		2 Openings		1 Opening		2 Openings		1 Opening		2 Openings	
CFM	Cm/m	In³	m³	In³	m³	inwc	kPa	inwc	kPa	inwc	kPa	inwc	kPa	inwc	kPa	inwc	kPa
0 - 750	0 - 21.24	230	0.0038			0.01	0.0025			0.01	0.0025			0.15	0.0374		
751 - 1000	21.27 - 28.32	330	0.0054			0.05	0.0125			0.05	0.0125			0.2	0.0498		
1001 - 1250	28.35 - 35.40	330	0.0054			0.1	0.0249			0.1	0.0249			0.2	0.0498		
1251 - 1500	35.42 - 42.47	330	0.0054			0.1	0.0249			0.1	0.0249			0.25	0.0623		
1501 - 1750	42.50 - 49.55	380	0.0062			0.15	0.0374			0.14	0.0349			0.3	0.0747		
1751 - 2000	49.58 - 56.63	380	0.0062	658	0.0108	0.19	0.0473	0.11	0.0274	0.18	0.0448	0.1	0.0249	0.3	0.0747	0.17	0.0423
2001 & Above	56.66 & Above	463	0.0076	658	0.0108	0.19	0.0473	0.11	0.0274	0.18	0.0448	0.1	0.0249	0.3	0.0747	0.17	0.0423

* Hogs Hair Filters are the type supplied with furnace (if supplied).

APPLYING FILTER PRESSURE DROP TO DETERMINE SYSTEM AIRFLOW

To determine the approximate airflow of the unit with a filter in place, follow the steps below:

1. Select the filter type.
2. Select the number of return air openings or calculate the return opening size in square inches to determine the proper filter pressure drop.
3. Determine the External System Static Pressure (ESP) without the filter.
4. Select a filter pressure drop from the table based upon the number of return air openings or return air opening size and add to the ESP from Step 3 to determine the total system static.
5. If total system static matches a ESP value in the airflow table (i.e. 0.20 w.c. (50 Pa), 0.60 w.c. (150 Pa), etc.,) the system airflow corresponds to the intersection of the ESP column and Model/Blower Speed row.
6. If the total system static falls between ESP values in the table (i.e. 0.58 w.c. (144 Pa), 0.75 w.c. (187 Pa), etc.), the static pressure may be rounded to the nearest value in the table determining the airflow using Step 5 or calculate the airflow by using the following example.

Example: For a 75,000 BTUH (21.98 kW) furnace with 2 return openings and operating on high-speed blower, it is found that total system static is 0.38" w.c. To determine the system airflow, complete the following steps:

Obtain the airflow values at 0.30 w.c. (75 Pa) & 0.40 w.c. (99.6 Pa) ESP.

Airflow @ 0.30": 1408 CFM (39.8 m^3/min)

Airflow @ 0.40": 1343 CFM (38.0 m^3/min)

Subtract the airflow @ 0.30 w.c. (75 Pa) from the airflow @ 0.40 w.c. (99.6 Pa) to obtain airflow difference.

1343 - 1408 = -65 CFM (1.89 m^3/min)

Subtract the total system static from 0.30 w.c. (75 Pa) and divide this difference by the difference in ESP values in the table, 0.40 w.c. (99.6 Pa) - 0.30 w.c. (75 Pa), to obtain a percentage.

(0.38 - 0.30) / (0.40 - 0.30) = 0.8

Multiply percentage by airflow difference to obtain airflow reduction.

(0.8) X (-65) = -52

Subtract airflow reduction value to airflow @ 0.30 w.c. (75 Pa) to obtain actual airflow @ 0.38 in wc (94.6 Pa) ESP.

1408 - 52 = 1356

TABLE 17: Blower Performance - CFM

UPFLOW, SINGLE SIDE RETURN (WITHOUT FILTER)																		
BTU/H (kW) Input / Output	Cabinet Size	Speed Tap	EXTERNAL STATIC PRESSURE, INCHES WC (kPa)															
			0.1 (0.025)		0.2 (0.050)		0.3 (0.075)		0.4 (0.099)		0.5 (0.124)		0.6 (0.149)		0.7 (0.174)		0.8 (0.199)	
			cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m
75/60 (22.0/17.6)[1]	B	High	1535	43.5	1470	41.6	1408	39.9	1343	38.0	1275	36.1	1202	34.0	1115	31.6	1014	28.7
		Medium	1215	34.4	1199	34.0	1182	33.5	1151	32.6	1106	31.3	1039	29.4	976	27.6	887	25.1
		Low	875	24.8	874	24.7	864	24.5	847	24.0	827	23.4	799	22.6	736	20.8	658	18.6
75/60 (22.0/17.6)[11]	C	High	1792	50.7	1724	48.8	1630	46.2	1552	43.9	1462	41.4	1367	38.7	1264	35.8	1152	32.8
		Medium	1597	45.2	1555	44.0	1496	42.4	1444	40.9	1372	38.9	1287	36.4	1190	33.7	1086	30.8
		Low	1115	31.6	1140	32.3	1167	33.0	1183	33.5	1149	32.5	1093	31.0	1023	29.0	939	26.6
100/80 (29.3/23.4)[2]	C	High	1888	52.9	1781	50.4	1690	47.9	1600	45.3	1498	42.4	1396	39.5	1277	36.2	1156	32.7
		Medium	1602	45.4	1553	44.0	1503	42.6	1447	41.0	1376	39.0	1287	38.4	1181	33.4	1060	30.0
		Low	1147	32.5	1147	32.5	1147	32.5	1147	32.5	1132	32.1	1078	30.5	1009	28.6	918	26.0
UPFLOW, DUEL RETURN, BOTTOM AND ONE SIDE OR TWO SIDE RETURN (WITHOUT FILTER) HORIZONTAL APPLICATION, BOTTOM RETURN (WITHOUT FILTER)																		
BTU/H (kW) Input / Output	Cabinet Size	Speed Tap	EXTERNAL STATIC PRESSURE, INCHES WC (kPa)															
			0.1 (0.025)		0.2 (0.050)		0.3 (0.075)		0.4 (0.099)		0.5 (0.124)		0.6 (0.149)		0.7 (0.174)		0.8 (0.199)	
			cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m
75/60 (22.0/17.6)[1]	B	High	1634	46.3	1562	44.2	1484	42.0	1417	40.1	1340	37.9	1238	35.1	1154	32.7	1030	29.2
		Medium	1243	35.2	1228	34.8	1214	34.4	1184	33.5	1133	32.1	1079	30.6	999	28.3	912	25.8
		Low	886	25.1	886	25.1	886	25.1	886	25.1	865	24.5	823	23.3	777	22.0	700	19.8
75/60 (22.0/17.6)[1]	C	High	1978	56.0	1896	53.7	1803	51.1	1693	47.9	1589	45.0	1478	41.9	1366	38.7	1235	35.0
		Medium	1682	47.6	1657	46.9	1606	45.3	1530	43.3	1455	41.2	1366	38.7	1265	32.2	1137	32.2
		Low	1235	35.0	1235	35.0	1235	35.0	1235	35.0	1198	33.9	1154	32.7	1083	30.7	987	27.9
100/80 (29.3/23.4)[2]	C	High	2122	60.1	2027	57.4	1916	54.3	1821	51.6	1717	48.6	1590	45.0	1462	41.4	1312	37.2
		Medium	1667	47.2	1696	48.0	1656	46.9	1597	45.2	1523	43.1	1438	40.7	1330	37.7	1191	33.7
		Low	1130	32.0	1145	32.4	1177	33.3	1194	33.8	1181	33.4	1146	32.5	1077	30.5	982	27.8
BLOWER PERFORMANCE CFM - BOTTOM RETURN (WITHOUT FILTER)																		
BTU/H (kW) Input / Output	Cabinet Size	Speed Tap	EXTERNAL STATIC PRESSURE, INCHES WC (kPa)															
			0.1 (0.025)		0.2 (0.050)		0.3 (0.075)		0.4 (0.099)		0.5 (0.124)		0.6 (0.149)		0.7 (0.174)		0.8 (0.199)	
			cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m	cfm	cm/m
75/60 (22.0/17.6)[1]	B	High	1552	43.9	1491	42.2	1420	40.2	1348	38.2	1271	36.0	1185	33.6	1080	30.6	970	27.5
		Medium	1229	34.8	1237	35.0	1198	33.9	1164	33.0	1105	31.3	1039	29.4	956	27.1	861	24.4
		Low	889	25.2	892	27.8	879	24.9	866	24.5	846	24.0	807	22.9	760	21.5	689	19.5
75/60 (22.0/17.6)[11]	C	High	1946	55.1	1862	52.7	1775	50.3	1620	45.9	1518	43.0	1409	39.9	1291	36.6	1160	32.8
		Medium	1683	47.7	1611	45.6	1551	43.9	1484	42.0	1388	39.3	1300	36.8	1190	33.7	1080	30.6
		Low	1110	31.4	1138	32.2	1175	33.3	1190	33.7	1175	33.3	1126	31.9	1041	29.5	937	26.5
100/80 (29.3/23.4)[2]	C	High	1997	56.5	1920	54.4	1822	51.6	1723	48.8	1620	45.9	1500	42.5	1355	38.4	1211	34.3
		Medium	1728	48.9	1679	47.5	1635	46.3	1556	44.1	1465	41.5	1359	38.5	1249	35.4	1117	31.6
		Low	1131	32.0	1156	32.7	1181	33.4	1190	33.7	1171	33.2	1126	31.9	1049	29.7	926	26.2

1. Return air is through side opposite motor (left side).
2. Motor voltage at 115 V.

Airflow expressed in standard cubic feet per minute (CFM) and in cubic meters per minute (m^3/min).

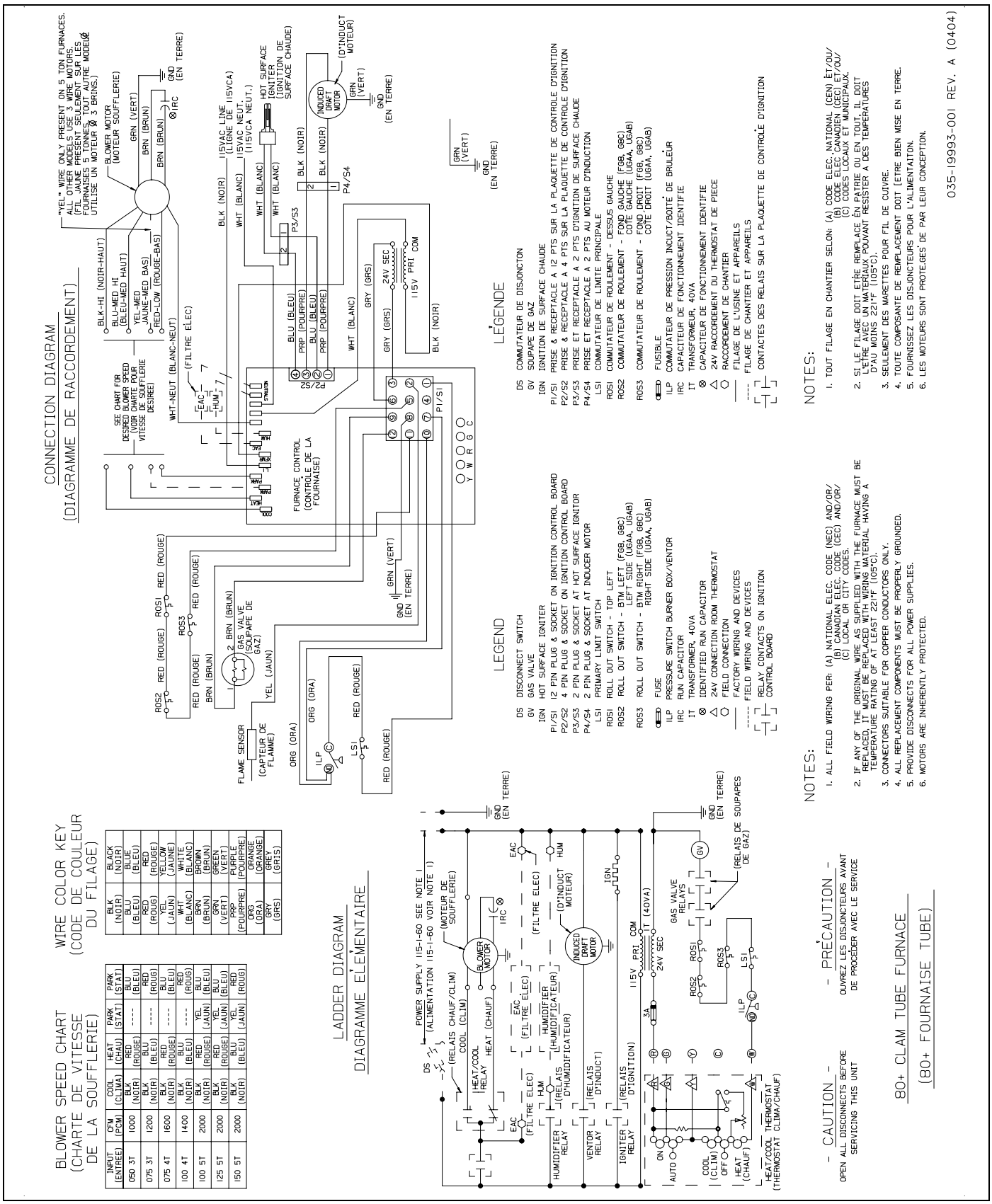
TABLE 18: Field Installed Accessories - Non Electrical

MODEL NO.	DESCRIPTION	USED WITH
1NP0805	PROPANE (LP) CONVERSION KIT	50, 7512
1NP0806	PROPANE (LP) CONVERSION KIT	7516, 10016
1LN0802	LOW NOX KIT	ALL MODELS
1FF0110	FILTER FRAME KIT	50, 7512
1FF0112	FILTER FRAME KIT	7516, 10016
1HA0802	HIGH ALTITUDE INSTRUCTION PACKET (DOES NOT INCLUDE ORIFICES)	ALL MODELS

TABLE 19: Field Installed Accessories - Electrical

MODEL NO.	DESCRIPTION	USED WITH
2TH07700124	THERMOSTAT-One-stage Heat, One-Stage Cool, with subbase	ALL MODELS
2TH13700424	THERMOSTAT-One-stage Heat, One-Stage Cool	ALL MODELS
2TB17700424	THERMOSTAT Subbase for 2TH13700424	ALL MODELS
2ET07700324	THERMOSTAT - Programmable	ALL MODELS
2ET07700224	THERMOSTAT- Deluxe Programmable, One-stage Heat, One-stage Cool with subbase	ALL MODELS

SECTION X: WIRING DIAGRAM



BLOWER SPEED CHART
(CHARTE DE VITESSE DE LA SOUFFLERIE)

INPUT (ENTRÉE)	CFM (PCM)	COOL (CLIMA)	HEAT (CHAU)	PARK (STAT)
050 3T	1000	BLK (NOIR)	RED (ROUGE)	---- BLU (BLEU)
075 3T	1200	BLK (NOIR)	BLU (BLEU)	---- RED (ROUGE)
075 4T	1600	BLK (NOIR)	RED (ROUGE)	---- BLU (BLEU)
100 4T	1400	BLK (NOIR)	BLU (BLEU)	---- RED (ROUG)
100 5T	2000	BLK (NOIR)	RED (ROUGE)	YEL (JAUN) BLU (BLEU)
125 5T	2000	BLK (NOIR)	RED (ROUGE)	YEL (JAUN) BLU (BLEU)
150 5T	2000	BLK (NOIR)	BLU (BLEU)	YEL (JAUN) RED (ROUG)

WIRE COLOR KEY
(CODE DE COULEUR DU FILAGE)

BLK (NOIR)	BLACK (NOIR)
BLU (BLEU)	BLUE (BLEU)
RED (ROUGE)	RED (ROUGE)
YEL (JAUNE)	YELLOW (JAUNE)
WHT (BLANC)	WHITE (BLANC)
BRN (BRUN)	BROWN (BRUN)
GRN (VERT)	GREEN (VERT)
PRP (POURPRE)	PURPLE (POURPRE)
ORG (ORA)	ORANGE (ORANGE)
GRY (GRS)	GREY (GRIS)

NOTES:
1. ALL FIELD WIRING PER: (A) NATIONAL ELEC. CODE (NEC) AND/OR/ (B) CANADIAN ELEC. CODE (CEC) AND/OR/ (C) LOCAL OR CITY CODES.
2. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 221°F (105°C).
3. CONNECTORS SUITABLE FOR COPPER CONDUCTORS ONLY.
4. ALL REPLACEMENT COMPONENTS MUST BE PROPERLY GROUNDED.
5. PROVIDE DISCONNECTS FOR ALL POWER SUPPLIES.
6. MOTORS ARE INHERENTLY PROTECTED.

NOTES:
1. TOUT FILAGE EN CHANTIER SELON: (A) CODE ELEC. NATIONAL (CEN) ET/OU (B) CODE ELEC. CANADIEN (CEC) ET/OU (C) CODES LOCAUX ET MUNICIPAUX.
2. SI LE FILAGE DOIT ÊTRE REMPLACÉ EN PARTIE OU EN TOUT, IL DOIT L'ÊTRE AVEC UN MATÉRIAUX POUVANT RÉSISTER A DES TEMPÉRATURES D'AU MOINS 221°F (105°C).
3. SEULEMENT DES MARETTES POUR FIL DE CUIVRE.
4. TOUTE COMPOSANTE DE REMPLACEMENT DOIT ÊTRE BIEN MISE EN TERRE.
5. FOURNISSEZ LES DISJONCTEURS POUR L'ALIMENTATION.
6. LES MOTEURS SONT PROTEGÉS DE PAR LEUR CONCEPTION.

FIGURE 34: Wiring Diagram

NOTES

NOTES

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